RAND

Public-Private Partnerships for Data Sharing: A Dynamic Environment

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DRU-2259-NASA/OSTP

April 2000

Prepared for the National Aeronautics and Space Administration and the Office of Science and Technology Policy

20000614 059

Science and Technology Policy Institute

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PREFACE

This report presents a RAND analysis of public-private partnerships focused on data sharing. Many different practical case studies, models of data sharing partnering, were analyzed to understand differences and similarities in the practical approaches to data sharing, especially geospatial data sharing. This report can provide useful information to federal policy makers about how to more effectively partner with non-federal partners. It should also be of interest to state and local governments, non-governmental organizations, researchers, and others who are interested in data sharing partnerships, especially those with interests in geospatial data.

This research was originally sponsored by the White House Office of Science and Technology Policy (OSTP) through RAND's Science and Technology Policy Institute.

Originally created by Congress in 1991 as the Critical Technologies Institute and renamed in 1998, the Science and Technology Policy Institute is a federally funded research and development center sponsored by the National Science Foundation and managed by RAND. The Institute's mission is to help improve public policy by conducting objective, independent research and analysis on policy issues that involve science and technology. To this end, the Institute

- Supports the Office of Science and Technology Policy and other Executive Branch agencies, offices, and councils
- Helps science and technology decisionmakers understand the likely consequences of their decisions and choose among alternative policies
- Helps improve understanding in both the public and private sectors of the ways in which science and technology can better serve national objectives.

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education, and other nonprofit institutions.

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SUMMARY

U.S. federal agencies have been conducting, participating and initiating numerous partnerships with private sector and other non-government entities in the last decade. There are many new opportunities and different approaches in conducting such public-private partnerships, especially in dynamic areas, such as information technologies and data sharing. Given such activities, federal organizations have interests in understanding how to effectively conduct such partnerships and to measure their success or failure. Such interests are especially strong for new programs and where there has historically been little to no partnering with the private sector, such as with the NASA Science Data Buy (SDB).

The Commercial Space Act of 1998 mandated that NASA's Earth Science Enterprise (ESE) acquire, when cost-effective, commercial remote sensing data for University and other research scientists to conduct research to advance the state of scientific understanding about our earth[1]. NASA is in a new and unique position in this program effort because the agency lacks institutional experience in purchasing data for scientific purposes. In addition, given this mandate, the SDB offers new collaborative opportunities between NASA, for-profit companies, and scientists.

THIS STUDY: PURPOSE AND APPROACH

This study attempts to provide insights about effective ways for federal government to conduct public-private partnerships for sharing data. This study analyzed a wide range of practical examples of public-private partnerships to understand the benefits and lessons learned about the federal government partnering with the private sector. This study focused on examining partnership models and issues that are most relevant for the NASA SDB. Given the mandate for the SDB, models that are most relevant involve (1) data sharing among many different users

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[1] Called the NASA Science Data Buy. It is explained in the introduction.

and supplier of data, especially geospatial data, and (2) federal government working with the private sector and non-governmental organizations (NGOs). Many different practical case studies, models of data sharing partnering, were analyzed to understand differences and similarities in the practical approaches to data sharing.

The research approach consisted of three main dimensions: literature review, expert interviews, and case studies. The study began with a general review about public-private partnership case studies and literature. Initially, a wide range of partnerships, collaborations, and data clearinghouse efforts that involve public-private partnerships or data distribution were investigated, over 50 such examples. Then the project focused more specifically on case studies that were most relevant for the SDB with an emphasis on the more successful and innovative approaches. About 30 different case studies were conducted in more detail to understand the many different models that are used in practice. Over 40 interviews were conducted with a diverse range of participants as part of the case study analysis. We analyzed these partnerships' operations and implementation approaches to understand key dimensions and different approaches employed. Finally, the cases were compared and contrasted to understand the differences and commonalties across the many different approaches and lessons learned for partnerships related to data sharing.

TYPES OF PARTNERSHIPS

Partnerships is a term that is overused and often misunderstood because so many people have different interpretations about the term's meaning. In this study a broad definition of partnerships was used. A partnership is an interaction that takes place between two different organizations before the consumer receives the final product.

There also are many different types of partnerships based on various factors, such as the relationships between entities or what function they serve. In examining the practical case studies of different public-private partnerships, we found it important to distinguish between different types of partnerships. These key distinguishions are briefly discussed here.

Distinguishing between different types of partnerships based on the relationships between entities

Team partnership. A team partnership is when a government organization enters in an exclusive agreement with a different organization. Such an organization may include a for-profit company, a University, an NGO, or even another type of government. A team is characterized by a close working relationship between the two entities that consists of a high level of shared risk, costs, and trusts. There also are clearly defined roles and structure in a team partnership.

Collaboration. A collaboration is a cooperative arrangement of multiple organizations, usually of different types. Such organizations may include federal, state, and local governments; foreign governments; for-profit firms; and Universities and other NGOs. In this partnership, different entities, often with very different motivations and interests, have come together for a common purpose and to share individual resources and strengths for shared benefits. A collaboration usually has more complex interactions between the different entities in the partnership. Because there are many different players with their own motivations and interests, a collaboration is often characterized by less trust and is less cohesive than a team.

Market. Both teams and collaborations are cooperative partnerships. A non-cooperative partnership is defined as a market. A market is where buyers and sellers meet and they do not need to really trust one another; they simply have a financial transaction.

It is important to note that these definitions are not mutually exclusive and not always clear cut. A partnership can include elements of all three types of partnerships. We found that a partnership effort may involve a group of teams, collaborations and markets.

Other partnership classifications

Traditional public-private partnership. A traditional public-private partnership is one where a government organization partners with one to few private sector companies. It is usually a team type of partnership where the partners roles are clearly defined. There is a high level of shared risks, costs, and trust. The partnership is focused on providing a clearly defined and well specified service,

product, or data for the government entity. The source of the data is also clearly defined and usually from a single source, usually the government or industry partner supplies it.

Data clearinghouse. A data clearinghouse is an organization that acquires, maintains, and distributes data or provides informational services about data for many different data users. Such an organization may also integrate the data, generate the data, or perform other types of data processing functions. A data clearinghouse may include many different types of partnerships to achieve its functions, including teams, collaborations, and markets.

RESULTS

In comparing and contrasting the partnerships we found it is important to look at lessons learned from traditional public-private partnerships and the more relevant data clearinghouse efforts. Basic findings are presented for the cases that we examined.[2] The more specific findings for the NASA SDB are presented in a forthcoming report that combines this practical case study analysis with economic and NASA specific analyzes.

Lessons from Traditional public-private partnerships

There are important lessons that can be learned from these traditional public-private partnerships. First, effectively implemented, such partnerships can provide benefits for government, companies, and the general public. Second, successful public-private partnerships build on the strengths of each organization to be able to do things that each organization would not do alone. Third, the federal government is able to take advantage of the commercial companies flexibility in the marketplace and their commercial and customer orientation.

Even though there are useful lessons learned from such traditional public-private partnerships, they have limited relevance to the NASA SDB

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[2] It is important to caveat the findings and avoid taking them out of context, given the fact that we mainly focused on a specific type of partnership - those involving data sharing among many different users and suppliers of data. Also, we had a limited number of case studies.

given their specific focus and close working team partnership structures. Since the SDB involves many different data types and applications, and data users and suppliers, it is more complex in terms of different organizations involvement and interests. A more relevant model, that the study focused on, is the data clearinghouse model.

Lessons from Data Clearinghouse Efforts

We found a range of similarities and differences across most of the successful clearinghouse examples. The individual partnership, collaboration, and data clearinghouse efforts are unique. These efforts are complex systems that are organized and implemented in many different ways based on each effort's mission, partners, history, and the legal and cultural circumstances. There were many differences but also many similarities in the implementation, structure, and operations of these clearinghouses. We briefly overview the main differences and similarities for key dimensions.

Organizational structure. There was a great diversity in the organizational structures of the successful cases. However, we did notice one important common factor in the organizational structures across almost all of the successful cases examined. Most of the cases examined have a unique center or even a separate non-profit organization created to run the data clearinghouse function. This center has a specific mission and is considered by the data user and supplier communities to essentially be a "neutral" entity in the sense that it clearly focuses on the interests of the clearinghouse. Namely, it is an objective party that focuses on its mission.

Services provided. We found that there was a wide range of services provided by the data clearinghouses. However, many of the successful clearinghouses have flexibility in services provided based on their user needs, and based on their mission and legal restrictions.

Management approaches. Management approaches varies quite a bit from one clearinghouse to another. Despite the many different management approaches we found one common factor in the successful data clearinghouse examples. Management was focused on the clearinghouse mission and perceived as "neutral" by data users and suppliers.

Irregardless of style or number of players involved in the management of the effort, the management did not have any significant conflicting objectives.

Pricing and data access deals. There were a wide range of pricing and access approaches and deals both in acquiring and providing datasets across and even within many of the clearinghouses. Despite the many differences in data pricing and access approaches of the clearinghouses, one similarity stood out across most of the clearinghouses. Most clearinghouses exploit creative pricing and access approaches based on their legal limits. The clearinghouses were aggressive and creative in their deal making approaches given their mission and operational restrictions.

Data quality and role of standards. There were also different approaches in handling data quality. However, we found that most of the clearinghouses assume the data producer is responsible for quality control unless the data clearinghouse created or modified the databases in any way. Then the clearinghouse is responsible for quality control. We also found that most clearinghouses use metadata and other standards as part of their quality control and assurance processes. In addition, we found that most of the efforts use or customize formal standards for their own needs and are active in standard making processes.

Role of User Communities. We found that for most of the successful data clearinghouses that the user communities have direct or indirect control of the efforts. User communities are controlling the clearinghouse efforts often through actual participation, representation, or their pocketbooks.

Technology Issues. The collaborations take advantage of technology advances and the underlying infrastructure provided by the technology. Almost all of the clearinghouse efforts have evolved significantly because of technology changes. It also appears that such trends are likely to continue.

Other commonalties. The clearinghouses, in their partnership efforts, take advantage of contributing organizations strengths and cultures. Each clearinghouse tends to recognize the different motivations and skills of contributing partners, data suppliers, and

users, and exploits theses differences to advance the clearinghouse efforts. Third, the clearinghouses adapt over time. This adaptation can include cost mechanisms, organizational structures, and technologies employed. Fourth, the systems and benefits are perceived as fair by participating entities. Namely, most potential data users and data suppliers see the clearinghouse as treating users and suppliers fairly. Last, these successful efforts receive a critical mass of support and technical infrastructure that enables them to sustain their efforts. Such support includes having sufficient leadership, funding, technological expertise, and other resources.

CONCLUSIONS

We found that currently there is a large amount of experimentation in partnership arrangements and implementation, especially for data sharing arrangements. Traditional views of public-private partnerships are limited. Partnerships are evolving over time. For example, today many data sharing partnerships are complex collaborations with more members and more members of many different types than in the past.

Evolving information technologies, such as the many-to-many communication mechanisms of the Internet, help fuel these new arrangements.

There are also new and changing roles in data sharing partnerships. First, users have greater control in data clearinghouse partnerships. Second, there is a decreased role for the traditional gate keepers, those who use to have tight control over how and who accessed data. Last, there is an increasing role for neutral facilitators. These facilitators are intermediate neutral organizations that help customers acquire data faster and cheaper.

Data sharing partnerships are a dynamic environment. This innovation is likely to continue, especially because of technology advances continuing. Given these partnership and technology trends, government's role in public-private partnerships is also changing and some agencies may need to rethink how they approach public-private partnerships for data sharing. Many different options should be

explored. In approaching data sharing, especially geospatial data, it is important to be flexible, open-minded, and dynamic.

ACKNOWLEDGMENTS

GLOSSARY

Symbol	Definition
ABI	Association for Biodiversity Information
BRD	Biological Resources Division
CIESIN	Center for International Earth Science Information Network
CITO	Central Imagery Tasking Office
CRADA	Cooperative Research and Development Agreement
CRSP	Commercial Remote Sensing Program
CSIL	Commercial Satellite Imagery Library
CUGIR	Cornell University Geospatial Information Repository
DAAC	Distributed Active Archive Center
DEP	Department of Environmental Protection
DOQ	Digital orthophoto quadrangle
EPA	Environmental Protection Agency, refers to U.S. Environmental Protection Agency.
EROS	Earth Resources Observation Systems
ESE	Earth Science Enterprise
ETV	Environmental Technology Verification
FGDC	Federal Geographic Data Committee
FOIA	Freedom of Information Act
FS	USDA Forest Service
GIC	Geospatial Information Council
GIS	Geographic Information System
GISCC	GIS Coordinating Committee
GISDC	GIS Data Clearinghouse

GPRA	Government Performance and Results Act of 1993
IP	Intellectual Property
ITWG	Interagency GIS Technical Working Group
JSTOR	Journal Storage Project
MGIC	Montana Geographic Information Council
MLGGC	Montana Local Government GIS Coalition
NASA	National Aeronautics and Space Administration
NBII	National Biological Information Infrastructure
NDDB	Natural Diversity Database
NGO	Non-Governmental Organization
NIMA	National Imagery and Mapping Agency
NOAA	National Oceanic & Atmospheric Administration
NRIS	Natural Resource(s) Information System. Note: Texas uses Resources and Montana uses Resource
NSDI	National Spatial Data Infrastructure
NYS	New York State
OGETA	Open Geodata Consortium
ONHP	Oregon Natural Heritage Program
ONRC	Olympic Natural Resources Center
OSTP	The White House Office of Science and Technology Policy
PASDA	Pennsylvania Spatial Data Access
PATH	Partnership for Advancing Technology in Housing
PNGV	Partnership for a New Generation of Vehicles
PPP	Public-Private Partnership
QC	Quality Control

R&D	Research and Development
RS	Remote sensing
SDB	Science Data Buy
SEDAC	Socioeconomic Data and Applications Center
TNC	The Nature Conservancy
TNRIS	Texas Natural Resources Information System
TWDB	Texas Water Development Board
US F&WS	United States Fish and Wildlife Service
USDA	United States Department of Agriculture
USGAU	United States Government and Affiliated User Status
USGS	United States Geological Survey
UWG	User Working Group
VAD	Value Added Developer
WISCLINC	Wisconsin Land Information Clearinghouse
WWW	World Wide Web

1. INTRODUCTION

**Public-Private Partnerships for
Data Sharing: A
Dynamic Environment**

**Beth E. Lachman
April 2000**

This briefing presents research conducted on public-private partnerships (PPPs) focused on data sharing. This research examined practical case studies. This research was part of a larger RAND public-private partnership study that was undertaken at the request of the White House Office of Science and Technology Policy (OSTP). OSTP has an ongoing interest in understanding how public-private partnerships might be used in pursuit of national science policy objectives. This larger project was funded and co-sponsored by NASA's Commercial Remote Sensing Program (CRSP)[3]. This documented briefing is intended to document the details of this partnership research for members of the project team, the client, and selected individuals who would find it helpful. Results from the larger study can be found in a forthcoming document.

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[3] NASA's Code Y, Stennis Space Center

Policy Background

Commercial Space Act of 1998: Mandated the Science Data Buy (SDB)

- **NASA's Earth Science Enterprise (ESE) buys commercial remote sensing data for their science mission**

- **$50 million allocated in 1999**

- **Data used by many different university scientists**

Only recently have commercial companies been licensed to sell satellite remote sensing data. The Commercial Space Act of 1998 focuses on space commercialization and privatization issues surrounding the launch sector, and the use of commercial remote sensing data to support civil Earth Science programs. Specifically, part of the Commercial Space Act of 1998 mandated that NASA's Earth Science Enterprise (ESE) purchase data from commercial remote sensing (RS) companies for the ESE science mission. NASA acquires, when cost-effective, commercial RS data for University and other research scientists to conduct research to advance the state of scientific understanding about our earth. This science must meet the ESE objectives. Such acquisitions can include space-borne and airborne Earth RS data, services, distribution, and applications from different commercial providers. This new NASA program is called the Science Data Buy (SDB). Congress allocated $50 million in 1999 for NASA to purchase data through the SDB. NASA is in a new and unique position in this program effort because the agency lacks institutional experience in purchasing data for scientific purposes. In addition, given this mandate, the SDB offers new collaborative opportunities between NASA, for-profit companies, and scientists.

Background: Research Context

RAND study to analyze public-private partnerships and their use of metrics
- **Use SDB as case study**
- **Help NASA think about best way to approach partnering and using metrics**
- **Observations about how others conduct similar partnership programs**
- **Partnerships about sharing data**

OSTP and NASA have co-sponsored a broader RAND study to analyze public-private partnerships and their use of metrics. Given the evolving federal interest and activity in public-private partnerships, especially in information technologies and data sharing, both organizations have interest in the broader issues of how to effectively conduct such partnerships and to measure their success or failure. The SDB is a useful case study for this research and to help NASA think about the best ways to approach partnerships related to remote sensing data and using metrics to measure the progress in such efforts. Like other federal agencies, NASA, must use measures to track progress in attaining program goals because of the Government Performance and Results Act of 1993 (GPRA). Such metrics are a challenge for NASA given the fact that performance is difficult to measure in an organization devoted to pure research.

Scott Pace and Dave Frelinger are the project leaders for this larger study. Mark Gabriele and Beth Lachman are RAND researchers that have been working on this study. In addition, Arthur Brooks, a economics professor from Georgia State University, is a consultant on the project. Arthur Brooks work provides an important economic and theoretical context about the dynamics of public-private partnerships

which complements the work presented in this briefing, i.e., Beth Lachman's practical research on public-private partnerships for data sharing. In addition, this practical research and document have benefited greatly from insights from all these team members.

It should be noted, that the more specific findings for NASA are presented in a forthcoming project paper, while this paper documents the details from the practical research on public-private partnerships for data sharing for a broader audience.

Objectives of this Research

Examine benefits and lessons about the federal government partnering with the private sector

Analyze different relevant partnership models

- **Sharing data among many different users and suppliers**

- **Federal government working both with the commercial sector and Non-Governmental Organizations (NGOs)**

Provide insights about effective ways to conduct public-private partnerships for sharing data

The first objective of this research was to analyze a wide range of practical examples of public-private partnerships to understand the benefits and lessons learned about the federal government partnering with the private sector. Second, this study's purpose was to provide insights about effective ways for federal government to conduct public-private partnerships for sharing data.

Since NASA has a desire to explore a variety of models for the acquisition and delivery of commercial data for the SDB, this research focused on examining many different partnerships models that were most relevant for the NASA SDB. Given the mandate for the SDB, models that are most relevant involve (1) data sharing among many different users and supplier of data, especially geospatial data, and (2) federal government working with the private sector and non-governmental organizations (NGOs[4]).

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[4] Non-governmental organizations refers to not-for-profit non-governmental organizations that can include Universities, environmental groups, research organizations, and other not-for-profit 501(c)(3) organizations.

Many different practical case studies, models of data sharing partnering, were analyzed to understand differences and similarities in the practical approaches to data sharing.

Outline

Research approach

Lessons from traditional public-private partnerships

Data clearinghouse models

Observations and conclusions

First this briefing presents some basic background information about the research approach and key definitions about different types of public-private partnerships. Next, the document describes lessons learned from the initial examination of more traditional models of public-private partnerships (which will be defined shortly). Third, the document discusses a more relevant type of partnership model, data clearinghouses, and presents the diverse range of such cases that were examined. Last, the presentation provides some observations and conclusions about public-private partnerships for data sharing from this research.

2. RESEARCH APPROACH

> ## Research Approach
>
> **Examined range of partnerships, collaborations, and data clearinghouse efforts that involve public-private partnerships or data distribution**
>
> **Conducting over 30 case studies to understand the different models being used in practice**
>
> **Analyzed a range of "successful" examples for insights**
>
> **Partnership: Interaction between two different organizations before consumer receives the product**

The study began with a broad focus on public-private partnership case studies and literature. Initially, a wide range of partnerships, collaborations, and data clearinghouse efforts that involve public-private partnerships or data distribution were investigated, over 50 such examples. Then the project focused more specifically on case studies that were most relevant for the SDB and that were "successful" in such efforts.[5]

About 30 different case studies were conducted in more detail to understand the many different models that are used in practice. We analyzed these partnerships' operations and organizational structures to understand key dimensions and different approaches employed. The cases were also compared and contrasted to understand the differences and

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[5] Later in this document what we mean by successful will be more clearly defined.

commonalties across the many different approaches. In conducting these cases, literature about the efforts was reviewed and over 35 telephone and in face interviews were conducted with a diverse range of participants in the partnership efforts. Each interview lasted from 20 minutes to over an hour. In some cases, additional follow-up interviews were conducted to gather additional information about the case study.

We need to caveat the reader about reading too much into this study since it was focused on a specific type of partnership. Additional research should be conducted in this area since it is a dynamic field and this study just touched the surface of many of the cases out there.

Partnerships is a term that is overused and often misunderstood because so many people have different interpretations about the term's meaning. What one person calls a partnerships someone else might not. In this research a very broad definition of partnerships was used. A partnership is an interaction that takes place between two different organizations before the consumer receives the final product. More specific definitions were used to distinguish between different types of partnerships.

Public-private partnerships is another term that is overused and often has many different definitions. Often a public-private partnership refers to a government partnering with a private for-profit company. However, governments also partner with non-profit organizations and other types of government, such as a federal agency partnering with a state agency. Private for-profit companies also partner with non-profit organizations. Such partnerships might be distinguished by terms such as public/guasi-private, public-public, and guasi-public/private partnerships based on the type of organization and the functions that the organizations play in the partnership.[6] However, in this paper, the term public-private partnerships is used to refer to a federal agency partnering with other non-federal entities, which can

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[6] Such distinctions were made in the larger RAND study and each of the cases studies in this paper were classified in these more detailed types of partnership classifications for the main study. However, such classifications are outside the scope of this paper so they are not used here.

include one or more of the following: a private for-profit company, an NGO, or a state agency.

Range of Partnerships: Defined by the Relationships Between Entities

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Team: Government and outside organization enter exclusive agreement
- Work closely together
- High level of shared risk, costs, and trust
- Clearly defined roles and structure

Collaboration: Cooperative arrangement of multiple organizations, possibly including federal, state and local governments, NGOs and industry
- Different motivations and interests; often less trust
- More complex interactions between entities
- Often less cohesive

Market: No cooperation; buyers and sellers meet

The relationship between the different entities involved in a partnership is an important way to distinguish between different types of partnerships. In examining the various practical case studies of different public-private partnerships three distinguishing definitions were developed.

First, is what we define as a team. A team partnership is when a government organization enters in an exclusive agreement with a different organization. Such an organization may include a for-profit company, a University, an NGO, or even another type of government. For example, a federal agency may partner with a state agency. A team is characterized by a close working relationship between the two entities that consists of a high level of shared risk, costs, and trusts. There also are clearly defined roles and structure in a team partnership. Many federal R&D partnerships are primarily a team.

The second type of partnerships is a collaboration. A collaboration is a cooperative arrangement of multiple organizations, usually of different types. Such organizations may include federal, state, and local governments; foreign governments; for-profit firms; and Universities and other NGOs. In this partnership, different entities, often with very different motivations and interests, have come together

for a common purpose and to share individual resources and strengths for shared benefits. A collaboration usually has more complex interactions between the different entities in the partnership. Because there are many different players with their own motivations and interests, a collaboration is often characterized by less trust and is less cohesive than a team.

Both teams and collaborations are cooperative partnerships. A non-cooperative[7] partnership is defined as a market. A market is where buyers and sellers meet and they are not trying to share anything and they do not need to really trust one another; they simply have a financial transaction. Many would not call a market a partnership. However, many government relationships that are referred to as partnerships are really markets. For example, some have called specific cases of a government agency contracting out a service a partnership. In many ways as currently implemented, the SDB is more like a market than a collaboration or team, since NASA purchases the data from remote sensing companies and supplies it to scientists.

It is important to note that these definitions are not mutually exclusive and not always clear cut. A partnership can include elements of all three types of partnerships. More complex partnership efforts often consist of multiple partnerships of different types. An effort may involve a group of teams, collaborations and markets, which will be illustrated later as specific cases are described.

Since these entity relationships are important to understanding partnership implementation, we ranked each case study on each of these partnership dimensions. Specifically, we classified each case as high, medium, low, or does not apply for each of these three partnership relationship types. This relationship ranking helped us to understand the nature of these partnerships and which were the most relevant models for this study and the SDB.

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[7] Non-cooperative does not mean uncooperative.

**Classifying Public-Private Partnerships
by Purposes**

Real property partnership: Physical property
involved

Service partnership: Focused on providing a
service, such as running a program for the
government

Virtual property partnership: Intellectual property
type partnership focused on providing data

Process partnership: Intellectual property type
partnership focused on processing information

In the study, we also classified public-private partnerships by the
main purpose or function that the partnership provides. There are four
classifications by purposes that the partnership performs for the
government. First, the partnership may mainly focus on sharing real
property, i.e. physical property. For example, a public-private
partnership is created so a company and government can share a facility
or equipment, such as a University lab or special computer. This
partnership is called a real property partnership. Second, the
partnership is created so that the private company provides a service
for the government agency, such as running a government program, called
a service partnership. Third, the public-private partnership may focus
on providing data, such as a partnership to develop a database; called a
virtual property partnership. Fourth, the public-private partnership
may focus on processing information, such as a partnership to conduct a
research study together and provide scientific insights. This
information processing partnership is called a process partnership. The
latter two types of partnerships involve intellectual property issues
and concerns. They also are most relevant for the SDB. Namely, since
the SDB consists of data and information and not physical property, nor
proving a service, the virtual property and process partnerships are

most relevant. Initially, we focused on a range of partnerships, but then we began to narrow our focus on these two latter types of partnerships.

3. LESSONS FROM TRADITIONAL PUBLIC-PRIVATE PARTNERSHIPS

Outline

Research approach

Lessons from traditional public-private partnerships

Data clearinghouse models

Observations and conclusions

Next we discuss some of the lessons learned from the first part of the research that focused on examining a wide range of partnerships before focusing on ones that were most relevant for the SDB. Namely, lessons learned by examining traditional public-private partnerships, such as R&D partnerships, rather than just focusing on efforts that involve data sharing from and to many different sources. First, we should define what is meant by a traditional public-private partnership.

Traditional Public-Private Partnerships

Key characteristics of traditional partnerships between government and industry

- **Government partners with one to few companies**

- **Focus on clearly defined data, product, or service**

- **Where data comes from also clearly defined and usually single source**

A traditional public-private partnership is one where a government organization partners with one to few private sector companies. It is usually a team type of partnership where the partners roles are clearly defined. There is a high level of shared risks, costs, and trust. The partnership is focused on providing a clearly defined and well specified service, product, or data for the government entity. The source of the data is also clearly defined and usually from a single source, usually the government or industry partner supplies it. Such partnership models are not as relevant for the NASA SDB. However, examining them provided some useful lessons about public-private partnerships.

Examples of Traditional Public-Private Partnerships Examined

NOAA-Maptech Cooperative Research and Development Agreement (CRADA)

EPA Environmental Technology Verification pilots

USGS/Microsoft "Terraserver" CRADA

Partnership for a New Generation of Vehicles (PNGV)

Partnership for Advancing Technology in Housing (PATH)

In the study a range of traditional public-private partnerships were analyzed. Such partnerships are mostly teams. Such PPPs were not as relevant for the SDB, but they offers some useful insights about successful public-private partnerships.

Several different Cooperative Research and Development Agreement's (CRADA's) were examined, including the NOAA-Maptech CRADA and the USGS/Microsoft "Terraserver" CRADA. A CRADA is special Research and Development (R&D) partnership agreement to help advance federal R&D and technology transfer from federal R&D.[8] A CRADA gives the federal agency and its industry partner more freedom in the collaboration process. Specifically, research and other data are excluded from the Freedom of Information Act (FOIA) to protect selected intellectual property rights of the effort so a company can benefit from such a partnership. Namely, a CRADA enables the private sector to collaborate with government in R&D and earn a fair profit from their efforts. In the next couple of

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[8] A CRADA is an agreement between a particular federal entity and one or more private companies, universities, or individuals under which money to support R&D can be accepted by the federal entity in exchange for the right to manufacture and market any patentable devices that may be developed during the agreement. CRADAs were authorized under the Technology Transfer Act of 1986 (Public Law 99-502).

briefing slides the NOAA-Maptech CRADA is discussed in more detail to illustrate how a traditional public-private partnership works and the benefits and lessons learned from such partnerships. The USGS/Microsoft "Terraserver" CRADA[9] is an R&D team partnership that focuses on providing digital orthophoto quadrangles (DOQs)[10] seeminglessly through the WWW.

Another class of partnerships examined were the U.S. Environmental Protection Agency's (EPA) Environmental Technology Verification (ETV) Program[11]. The ETV Program consists of twelve different public-private partnership pilots that are designed to verify the performance of innovative technical solutions to problems that threaten human health or the environment. The ETV Program verifies commercial-ready, private sector technologies through twelve pilot programs in different technology areas including the advanced monitoring, the air pollution control, and the greenhouse gas technology pilots. Diverse partners from mostly for-profit companies and non-profit NGOs are the individual partners. Each of these 12 pilots consists of team partnerships that provide the verification program service for EPA. Specifically, the partners perform and report verification activities based on testing and quality assurance protocols in collaboration with EPA experts. Because each of these ETV partnerships consists of a close working relationship focused on providing a specific service they are not very relevant for the SDB.

Two other R&D partnerships, the Partnership for a New Generation of Vehicles (PNGV)[12] and the Partnership for Advancing Technology in Housing (PATH)[13], were also examined, but because they fit into the

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[9] For more information on the USGS/Microsoft "Terraserver" CRADA see http://terraserver.microsoft.com/about.asp

[10] A DOQ is a computer generated image of an aerial photograph in which displacements caused by camera orientation and terrain have been removed.

[11] For more information about ETV see http://www.epa.gov/etv/

[12] For more information about PNGV see http://www.uscar.org/pngv/index.htm and Chapman, 1998.

[13] For more information about PATH see http://www.pathnet.org/about/about.html

traditional public-private partnership model, they also are not directly relevant for the SDB.

Relevant Example: NOAA-Maptech CRADA

Partnership to provide electronic nautical charts, formerly available only by paper from NOAA
- **NOAA provides raw data exclusively to Maptech**
- **Maptech adds value and sells it as product**
- **100 Value Added Developer (VAD) agreements to provide software to accompany electronic charts**

Close working partnership between equal entities
Takes advantage of partners' strengths
- **Commercial sector's customer responsiveness, marketing, pricing, and deal making flexibility**
- **NOAA's R&D and nautical chart 'name' brand**

The NOAA-Maptech CRADA[14] is a good example of a traditional public-private partnership that offers useful insights about public-private partnerships. This partnership is a close working team that has many benefits for government, private companies, and the public sector. NOAA and the for-profit company, Maptech, have partnered to produce electronic nautical charts.

A nautical chart is a map that shows information, such as water depths and traffic control schemes, that is critical to the safe and efficient use of the nation's waterways. NOAA is required to produce such paper charts. Certain high risk and high value vessels, such as large vessels over 1600 tons, are required by Federal regulation to carry these nautical charts for safety reasons. It is important to note that most of the shipping and boating marketplace, 99%, is not required by any law to carry these nautical charts. However, such vessels may also carry them because of their usefulness and for safety reasons.

NOAA started requiring that its staff develop electronic versions of the nautical charts. However, the staff did not receive any additional manpower or dollars to provide this new electronic chart

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[14] For more details about the NOAA-Maptech CRADA see the appendix.

production service, so they developed a public-private partnership to perform this function which did not require any government funding. Using a CRADA mechanism, Maptech, now produces and sells CD ROMs containing electronic nautical charts which use to only be available in paper format through NOAA. Under the CRADA between NOAA and Maptech the company has exclusive access to NOAA digital chart data and certain technology. Such exclusive access to government data are provided through the CRADA agreement. In exchange for such exclusive rights Maptech must produce all charts that meet NOAA standards (not just the profitable ones); issue new editions when NOAA does; provides an update service; make the results openly available to all at an affordable price; and must do so in perpetuity.[15] Maptech produces and sells CD ROMS of the electronic charts called Chartkits. Maptech at their own risk and expense makes these official electronic charts in collaboration with NOAA and profit or lose in the marketplace based on the success of their sales.

Maptech also adds value to the product to make it more marketable. Maptech had to be more creative than the government would have been to make their electronic chart production commercially viable. For example, they added value to the NOAA charts in their final product by adding additional features and capabilities, such as adding place names on the charts. They are in the process of adding digital orthophoto quadrangles (DOQs) to the charts to include visual reference.

Maptech has also developed a network of over 100 registered Value Added Developers (VADs) to provide software to go with the electronic chart products. These VAD companies develop, produce, and sell special market navigation software that uses the chart databases. For instance, a VAD may create a special software system using the charts for the kayaker or fisherman market. By developing such new specialty products the chart products are being sold in new niche markets.

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[15] The NOAA-Maptech CRADA is a four year agreement that is automatically extended for another four years and so forth indefinitely, unless either party officially chooses to terminate the agreement when it comes up for renewal every four years.

Each partner brings unique strengths to the effort that their partners benefit from. Maptech takes advantage of the NOAA brand name in their marketing and NOAA's R&D and data expertise. NOAA takes advantage of Maptech's ability to enhance the product, to widely market it and to be creative and flexible in their pricing and deal making. For instance, Maptech has frequent updates and upgrades of the product, which increases demand and generates sales of the revised products to existing as well as new customers. Maptech also provides special discounts to the official chart agents.

This CRADA offers useful insights about public-private partnerships, because it has successfully matched private sector's marketplace incentives and flexibility with government expertise and mission requirements.

NOAA-Maptech CRADA Has Many Benefits

Benefits for government, i.e. NOAA
- **Meet new mission of providing electronic charts without having to pay for it**
- **NOAA R&D has been enhanced**

Benefits for the public
- **Electronic chart product self-supported by sales, instead of by taxpayers**
- **Increased sales of charts and reached new markets**
- **Most likely wider use of charts and increased public safety**

The NOAA-Maptech CRADA has provided many benefits to the government and the public. NOAA is meeting its new mission requirement to provide electronic nautical charts without it costing NOAA nor the taxpayer any additional funds. The electronic chart products are totally self-supported by sales. In fact, NOAA estimates it avoids over $3 million of expenses per year and over 12 government FTEs, that would have been needed to perform the same electronic chart production, marketing and sales function that Maptech performs.[16]

NOAA R&D is also enhanced, because NOAA receives an R&D co-payment from all sales of these products. These R&D co-payments are only used to fund NOAA R&D on electronic charting. NOAA receives 5% of the gross sales of all electronic chart products, which amounts to about $100,000 per year. In addition, NOAA R&D benefits from real world feedback from Maptech which NOAA researchers use in their R&D. Maptech will point out to NOAA that they should gather additional data or process the data in a different way given the market demand.

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[16] This estimate is based on the amount that the private company spent during the first two years to develop, manufacture, and market this product.

There are also numerous benefits for the public. A high quality product is available to the public at an affordable price. The retail price for a Chartkit CD ROM is $199.95 per region and each CD contains about 55 charts per region depending on the size of the region which works out to a price of about $3.60 per chart. To purchase an individual electronic chart on a diskette costs $14.95 each. NOAA's paper charts cost about $15.65 each. (NOAA negotiated a cap on the retail price of the electronic chart products.)

This product is being self-supported by sales instead of taxpayer dollars. It also is an enhanced and more marketable product than NOAA would have provided itself. For instance, Maptech suggested NOAA provide Maptech with their electronic information about their Marine Sanctuaries[17], because it is something the general boating public would be interested in. Maptech will incorporate this information into the product, which provides additional value to the product and helps NOAA in their educational mission to distribute information about the Marine Sanctuaries. Such an idea probably would not have occurred to the NOAA researchers.

The paper charts sales have remained the same. However, as of summer 1999, the electronic charts were outselling paper charts 8 to 5, even though very large ships were still legally required to carry the paper charts for official navigational purposes. Given the increase in sales of the electronic charts compared to paper, the electronic charts are likely reaching new users, such as recreational boaters, and thereby, likely increasing public safety.

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[17] A Marine Sanctuary is like a national park in marine areas. Specifically, selected marine areas identified for their biodiversity, ecological integrity, and cultural legacy receive special protection through the National Marine Sanctuaries Program. About twelve areas throughout the United states have been designated as Marine sanctuaries. For more information about these sanctuaries see:
http://www.sanctuaries.nos.noaa.gov/natprogram/natprogram.html

Other Impacts of NOAA-Maptech CRADA

Benefits for the private sector: **New products and profits**

- **Maptech has healthy electronic chart business**
- **Over 30 VAD firms selling software products**
- **600 retail chart agents have new product sales**

Potential disadvantages

- **Maptech's competitors at economic disadvantage**
- **Could hurt long-term market competition**
- **Not optimal in long term because potentially more public benefit if more private competition?**

The NOAA-Maptech CRADA has also provided many benefits for the private sector. Maptech has a healthy electronic chart business. Also, as of summer 1999, over 30 VAD software products were on the market. These software developers are able to produce navigation software in a less risky environment because they are guaranteed the availability of high quality, affordable, consistent format and official data coming from the CRADA. There are about 600 small retail chart sales agents that are the official retailers of NOAA's paper charts. They now also sell Maptech's CD ROMS and the accompanying VAD software. These agents were originally against the CRADA, but now they support it because they have also benefited from this agreement. They have benefited because they have additional products that they can sell that have a higher net profit than the paper charts, namely, the CD ROM's and the accompanying software products.

However, despite the many benefits, there are always tradeoffs and pluses and minuses in such arrangements. There are some potential disadvantages to this agreement. The CRADA certainly gives Maptech a competitive advantage with the official NOAA brand name associated with the data in their product. One could speculate that it may hurt long-term market competition. However, currently there is still competition

since there are at least four other producers of such electronic chart products beside Maptech. Other companies with innovative electronic charts can enter the market at any time, so it is not legally a monopoly. Given current technologies, such competitors can easily scan NOAA's paper charts to develop their own electronic data products. However, in this case, the question arises whether or not the public may have benefited even more if there were more market competition. Such a case might occur if this partnership agreement did not grant Maptech exclusive rights to the data forever. For example, if the agreement stated that after 6 years the nautical chart data, even current data, would be available to anyone.   In such a situation, there may have been even more competition in this marketplace resulting in reduced prices and more availability of the products throughout the world. However, one might counter argue that a private sector company would not have been willing to enter such an agreement or else not invested so fully in the product under such conditions because of the small size of the overall market.

> **Lessons Learned from Traditional Public-Private Partnerships**
>
> **Important lessons**
> - **Provide benefits for the government, the public, and industry**
> - **Build on the strengths of each organization**
> - **Take advantage of commercial marketing flexibility**
>
> **Limited relevance for SDB, since SDB involves many different**
> - **Data types and applications**
> - **Suppliers and users**

There are important lessons that can be learned from these traditional public-private partnerships. First, effectively implemented, such partnerships can provide benefits for government, companies, and the general public.

Second, successful PPPs build on the strengths of each organization to be able to do things that each organization would not do alone. Government and industry have very different cultures and incentives. Culturally, industry has more flexibility while government has more restrictions on what they can do and how they do it. In addition, government's timelines to complete tasks often are slowed by bureaucratic requirements while in industry acting fast to gain competitive advantage in the marketplace is key. Exploiting these different cultures and strengths can lead to a very effective partnership. For example, in the NOAA-Maptech CRADA effort, Maptech is much more customer oriented and enhances the product in ways that would never have occurred to NOAA, such as including the information about their Marine Sanctuaries in the chart products.

Third, the federal government is able to take advantage of the commercial companies flexibility in the marketplace and their commercial orientation. Since government has many restrictions on how they can do

business and they are not use to operating in a free market economy, the private sector partner usually can more fully exploit the forces of the commercial marketplace. For example, in the NOAA-Maptech CRADA, Maptech thought more broadly about potential consumers and the marketplace, such as targeting commercial and recreational boaters in their product development plan. Maptech recognized that the marketplace was fragmented and that to make the chart production profitable a marketing plan was needed that enabled the product to be customized for the unique niche markets, which led to the VAD agreements. Maptech also quickly changes the product to meet user's needs, which NOAA probably would not have done had they produced the electronic charts.

Even though there are useful lessons learned from such traditional public-private partnerships, they have limited relevance to the NASA SDB given their specific focus and close working team partnership structures. Since the SDB involves many different data types and applications, and data users and suppliers, it is more complex in terms of different organizations involvement and interests. This naturally leads to the question of what types of partnerships are more similar and relevant for the SDB?

**Other Partnering Models that Might
Be Relevant ?**

**Focus on models of <u>sharing data among many
different users and suppliers</u>**

- **Mixing data from many different sources**
- **Government, scientists, or industry involved**
- **Innovative pricing and cost mechanisms**
- **Intellectual property (IP) concerns arising**
- **Geospatial or remote sensing data involved**

Because of the differences between traditional public-private
partnership models and data sharing situations like the SDB, we decided
to focus on partnership cases that are most relevant to the SDB. What
types of partnership models are most relevant? Given our initial
analysis about the different types of partnerships certain attributes
seemed most important to focus on.[18] First, the partnership should
involve data that come from many different suppliers and are used by
many different users. Second the partnership should involve mixing or
integrating data from many different sources. Third, a partnership that
involves a combination of government, industry, and or University
scientists or other NGOs is more relevant. Fourth, we are interested in
exploring partnership cases that employ a diverse range of innovative
pricing and cost strategies, because of cost efficiency desires for PPP
implementation. Fifth, we are interested in partnerships where
intellectual property concerns are involved, because such issues arise
when dealing with commercial remote sensing companies. Lastly, models
that involve remote sensing or other geospatial data are more relevant.

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[18] This research analyzed relationships between entities and
services provided as well as other key dimensions of PPPs to figure out
which PPP models would be most relevant.

Not every partnership had to meet all these criteria. However, we tried to focus on cases that met most of them and at least met the first. Namely, the minimal requirement was that the partnership effort had to involve sharing data among many different users and suppliers and meet many of the other criteria. Using these criteria to identify partnership examples it became clear that one type of partnership model was most relevant.

Directly Relevant Model: Data Clearinghouses

Data Clearinghouse/Integrator means

- **An organization that distributes, acquires, maintains, or integrates data, or provides informational services for many different data users**
- **May have partnerships that consist of teams, collaborations, or markets to perform its function**
- **Often a lead organization to run the clearinghouse if collaboration involved**

The partnership model that fits all these criteria is a data clearinghouse. Clearly, NASA is essentially serving a data clearinghouse type of role in the SDB. First, we must define how we are using this term. Some use the term data clearinghouse to refer to just the function of acquiring and providing data while the term integrator refers to the function of processing different datasets into a uniform system of data. Our definition includes both these functions. Given our research about these diverse partnerships and the many different activities that they conduct, we use this broader definition of data clearinghouse. A data clearinghouse is an organization that acquires, maintains, and distributes data or provides informational services about data for many different data users. Such an organization may also integrate the data, generate the data, or perform other types of data processing functions. A data clearinghouse may include many different types of partnerships to achieve its functions, including teams, collaborations, and markets. If a collaboration is involved in conducting the clearinghouse there is often a lead organization that physically operates the clearinghouse.

4.   DATA CLEARINGHOUSE MODELS

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Outline

Research approach

Lessons from traditional public-private partnerships

Data clearinghouse models

Observations and conclusions

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Next, this document overviews the many different data clearinghouse cases examined. First, different key dimensions that distinguish the different efforts are briefly discussed. Then, many of the specific case study examples are presented, to illustrate the diversity of these key dimensions within data clearinghouse efforts. The next section presents observations about important differences and commonalties across the many different case studies, as well as more general observations and conclusions.

Note that not every case is included in this section, however, many are included. The reader may choose to skip over some of the individual cases.

Focus on "Successful" Cases

Examined range of models, focusing on data clearinghouse examples that have
- **Successful implementation**
- **Innovative approach if too soon to evaluate success**

"Successful" implementation means
- **Goal attainment**
- **Customer satisfaction or high level of use by potential customers**
- **Efficiency of operations**
- **Adequate resources**

In choosing data clearinghouses as case studies, we tried to focus on ones that appeared to have "successful" implementation. "Successful" implementation means that the activity has achieved four things. First, the effort has achieved its goals. Such goal attainment includes meeting both mission and financial goals. For example, a financial goal may be to achieve full cost recovery, while a mission goal may be to widely disseminate geospatial data to all state agencies. Second, the effort must have customer satisfaction. High level of use by potential customers is one indication of customer satisfaction. Third, the effort should achieve some efficiency in its operations. A performance measure to track the operation's efficiency level might include the ratio of the amount of money spent on the effort divided by the number of users. Last, the effort needs to have adequate resources to sustain it in its mission. Adequate resources refers to sufficient financial, technical and political support to meet its goals. These four performance measures are discussed in more detail in organizational performance literature.[19]

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[19] See Kushner, Roland J., 1996, for an example.

However, we should point out that this study was not an evaluation of clearinghouse efforts. Our focus was on identifying and understanding some of the differences and similarities in the range of clearinghouse efforts, with an emphasis on examples that seem to demonstrate success. We did not conduct a detailed evaluation of the cases to actually measure their success. Another study would be needed to adequately judge the level of success of these clearinghouses with such specific performance measures.

In addition, we also examined some recent data clearinghouse efforts because of their innovative approaches and direct relevance even though it is too soon to judge success for some of these cases. For example, many of the new state geospatial data clearinghouse are new, but since they are so directly relevant and have some innovative approaches we included them. Given the fact that the use of geospatial technologies, especially RS data, is still a fairly recent phenomena it was natural to focus on some newer efforts.

Therefore, when we use the term "successful" we are referring to clearinghouses that appear to be successful or are currently implementing a new and innovative approach. Successful is a subjective term. We have not conducted a through analysis of the clearinghouses measures of success.

> # Range of Clearinghouse Models: Key Dimensions
>
> **Type of Organizational Structure: Combinations of teams, collaborations, and markets**
>
> **Services Provided: Minimal to extensive from information broker only to data purchaser, maintenance, and distributor**
>
> **Management Approach: Centralized to de-centralized; strong control to hands off**
>
> **Pricing and Cost Approaches: Free, fixed price, subscription and bulk rates, negotiated by individual users and suppliers**

Within data clearinghouse themselves there is a wide range of models in how they are implemented. Four key implementation dimensions were identified and investigated in all of the cases. These dimensions are: organizational structure, services provided, management approach, and pricing and cost mechanisms employed.

In this research, the full range of each of these dimensions were covered within the case studies. Specifically, in terms of organizational structure the case studies included a diverse combination of teams, collaborations, and markets. Services provided by the clearinghouse case studies ranged from minimal to extensive. For instance, we looked at clearinghouses that were only information brokers, such as just providing metadata, to clearinghouses that did just about everything, including purchasing, creating, cleaning, maintaining and distributing databases. Management approaches ranged from highly centralized to highly decentralized, and strong management control to almost no management control.

A wide range of pricing and cost approaches were also examined. Some cases did not try to recover costs while others were full cost recovery operations. Some clearinghouses provided the data for free, while others had fixed price, fee-for-service and/or subscription fees.

Some cases had bulk rates for data purchasing, or acquired data for free, at cost and/or market prices. Many negotiated different prices based on data sources. Such diverse pricing mechanisms applied for both data users and suppliers.

Examining such a diverse range of clearinghouse models helped us identify many different options for NASA to think about in their SDB.

Cases Examined

National Spatial Data Infrastructure(NSDI) Nodes

State Geospatial and Geographic Information Systems (GIS) Centers

The Nature Conservancy/Natural Heritage Program

EROS Data Center

Center for International Earth Science Information Network (CIESIN)

Journal Storage Project (JSTOR)

NIMA's Central Imagery Tasking Office (CITO)

Most of the 30 in-depth case studies conducted for this study were data clearinghouse models. This slide shows most of the main data clearinghouse model types examined in the study. The first three refer to groups of clearinghouses examined: USGS National Spatial Data Infrastructure (NSDI) Nodes; State Geospatial and Geographic Information Systems (GIS) Centers; and The Nature Conservancy and the Natural Heritage Program. For each of these groups there is a slide that explains the general category and then at least two specific examples within the group. These groups are not mutually exclusive. There is overlap between them. For example, in Montana the Montana Natural Resource Information System (NRIS) runs the state GIS Clearinghouse which is also an NSDI node. Montana NRIS also runs Montana's natural heritage program. Such cases with overlap only appear once in this study.

Other data clearinghouse examples examined include: the Earth Resources Observation Systems (EROS) Data Center, the Center for International Earth Science Information Network (CIESIN), the Journal Storage Project (JSTOR) and National Imagery and Mapping Agency's (NIMA's) Central Imagery Tasking Office (CITO).

For each of these cases one slide is presented to overview the key dimensions of the clearinghouse effort. To save time the reader may choose to skip over some of these individual cases. Other cases, such as MetroGIS and Wisconsin Land Information Clearinghouse (WISCLINC), are not presented here. Such cases were not presented for a variety of reasons, including not wanting to overwhelm the reader with too much detail and that other cases were similar enough, more interesting, further along in their effort, or appeared more successful than the case not included.

National Spatial Data Infrastructure (NSDI)

USGS funds through the NSDI Cooperative Agreements Program 174 different projects to develop NSDI database clearinghouses nodes

Projects create NSDI nodes to

- **Establish database clearinghouses to access and distribute geospatial data**
- **Develop standards related to geographic data**
- **Implement educational programs**
- **Build relationships among organizations to support digital geographic data coordination**

The National Spatial Data Infrastructure (NSDI)[20] encompasses policies, standards, and procedures for organizations to cooperatively produce and share geographic data. The 16 federal agencies that make up the Federal Geographic Data Committee (FGDC)[21] are developing the NSDI in cooperation with organizations from state, local and tribal governments, the academic community, and the private sector.

An important part of the NSDI is the establishment of a National Geospatial Clearinghouse. This National Geospatial Clearinghouse is using Internet technology and a distributed network of clearinghouse server nodes in all states and regions of the U.S. These state and regional nodes are called NSDI clearinghouses nodes and geospatial clearinghouses can voluntarily become nodes within this network. The NSDI helps facilitate the development and connection of such nodes through providing seed funding, a web site, standards, technology and policies, and helping to create clearinghouse partnerships.

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[20] See the NSDI web site for additional information about the NSDI: http://fgdc.er.usgs.gov/nsdi/nsdi.html

[21] The FGDC is charged with the responsibility to coordinate various surveying, mapping, and spatial data activities of federal agencies to meet the needs of the Nation. It is coordinated through the USGS. For more information on the FGDC see: http://www.fgdc.gov/

The USGS currently funds 174 different projects across the country to develop such NSDI database clearinghouses. USGS provides seed money to these many different clearinghouses to help promote public access to geospatial data. Specifically, projects funded under the NSDI Cooperative Agreements Program use technology, networking, and enhanced coordination to: establish clearinghouses to find and access geospatial data; develop standards related to geographic data; implement educational programs to increase awareness and understanding of the NSDI; and build or strengthen relationships among organizations to support digital geographic data coordination.[22]

In this study, over a dozen of these nodes were at least briefly examined, including: the Olympic Natural Resources Center (ONRC), Ohioview, Pennsylvania Spatial Data Access (PASDA), Wisconsin Land Information Clearinghouse (WISCLINC), MetroGIS, Allegheny GIS Consortium, and Montana NRIS GIS Clearinghouse. We tried to focus on examples that met most of our criteria and covered a range of models in terms of scope and implementation styles. We mostly examined the longer running and more successful nodes based on USGS and state GIS experts recommendations. A few others were examined to try to capture the range of efforts. ONRC, Ohioview, PASDA are briefly discussed in this document to illustrate the diversity of these efforts. A few of the others, such as Montana's effort, are discussed when the State GIS Center examples are presented, because they are both NSDI nodes and state GIS Centers.

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[22] See the NSDI Cooperative Agreements Program funding web site for additional information about each state's clearinghouse efforts: http://130.11.52.184/servlet/CoopAgreeServlet?State=None

**Olympic Natural Resources Center (ONRC)
Clearinghouse**

**NSDI Node: Partnership of USGS, the University of
Washington, and Olympic Natural Resources Center**

**Metadata archive of Olympic Peninsula geospatial and
biological data using FGDC and NBII standards**

ONRC contains both industry & government metadata

Metadata informational service only

- **Anybody can access their metadata through WWW**

- **Users contact data suppliers directly to acquire
datasets**

The Olympic Natural Resources Center (ONRC) Clearinghouse[23] is an
NSDI clearinghouse node for the Olympic Peninsula. The ONRC
clearinghouse is a metadata archive of Olympic Peninsula geospatial and
biological data. This center brings together natural and cultural
resource information reflecting the region's diverse marine and
terrestrial ecology, land ownership, and land use. Compiled metadata
complies with Federal Geographic Data Committee(FGDC) and National
Biological Information Infrastructure(NBII)[24] metadata content
standards. The ONRC clearinghouse is a partnership between the USGS
Forest and Rangeland Ecosystem Science Center, the University of
Washington Field Station and the Olympic Natural Resources Center. The
University of Washington Field Station is a unit in the USGS Biological

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[23] For more detailed information about ONRC see their web site at:
http://cathedral.cfr.washington.edu/~chouse/

[24] The National Biological Information Infrastructure, a USGS-led
initiative, refers to the development of an electronic "federation" of
biological data and information sources. Organizations voluntarily
partner and share biological information as part of the NBII. The goal
of the NBII is to provide swift user access to biological databases,
information products, directories, and guides maintained by Federal,
State, and local government agencies, non-government institutions, and
private sector organizations. For more information about the NBII see
http://www.nbii.gov/about/index.html

Resources Division. The Olympic Natural Resources Center is funded by a state agency and the facility is located at the University of Washington in Forks, Washington.

Individual organizations can voluntarily choose whether or not to put their metadata into the ONRC clearinghouse system. This clearinghouse contains data from many different federal agencies including the USDA Forest Service, USGS, the National Park Service, EPA, US Fish and Wildlife Service(F&WS), and NOAA. They also have metadata from state and local governments, environmental groups, some tribes and private sector companies. Companies are not as willing to enter their metadata. However, a couple timber companies have entered their metadata into their system. Anybody can access ONRC's metadata for free through the web. To actual acquire the datasets users contact the data suppliers directly and work out the acquisition deals.

In the future the ONRC clearinghouse plans to make some actual data available through their system. They plan to put up some LANDSAT image data for viewing purposes only.

To summarize, this data clearinghouse serves as an informational broker only. It is the simplest type of model with low costs. This clearinghouse model provides voluntary metadata only. No data purchasing fees are involved and users contact the original data supplier directly themselves to acquire datasets.

The next example is a more sophisticated model of an NSDI node and data clearinghouse model.

Ohioview

Consortium of state universities, USGS, NASA, OhioLINK, Ohio Supercomputer Center, and OARnet

Mission low-cost distribution of US government civilian satellite data for public use in Ohio

- **Initial focus on making Landsat 4, 5, and 7 data available for University scientists**
- **Plan to purchase all Ohio Landsat 7 satellite images**
- **Trying to work deal with SpaceImaging to acquire Landsat 4 and 5 at discounted rate for members**
- **US government and affiliated users status so can purchase data at federal government prices**

Ohioview[25], an NSDI clearinghouse node, is a complex collaboration partnership designed to acquire and provide datasets for Ohio University scientists. Ohioview is a consortium of state universities, the USGS EROS Data Center, the NASA Glenn Research Center, OhioLINK, The Ohio Supercomputer Center, OARnet, and NASA Research and Education Network. The Ohio Library and Information Network, OhioLINK, is a consortium of Ohio's college and university libraries and the State Library of Ohio. As an NSDI node, the Ohioview project received a small amount of seed funding, $30,000. from USGS. Additional funding comes from the other consortium partners.

Ohioview's mission is to promote the low-cost distribution of US Government civilian satellite data for public use in Ohio. The idea is to create a public library for sharing remote sensing data on Ohio, which will be used for science and government purposes to promote the public good. The current focus of the consortium is to make Landsat 4, 5, and 7 data available for their members. Ohioview's members are University researchers and scientists.

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[25] For more detailed information about Ohioview see the clearinghouse web site at: http://www.ohioview.org/

Because of the Land Remote Sensing Act of 1992 Landsat 7 data is available at the cost of distribution. Once Ohioview acquires the data it they can legally share it with their University members. Therefore, Ohioview plans to purchase all 9 of the Landsat 7 satellite images that cover Ohio every 16 days. They will have available a new complete picture of the state every 16 days. The University scientists will be able to get this new data free. However, they may have a commercial vendor actually sell some of this data for them to their members at a reasonable price.

Older data from Landsat 4 and 5 is more problematic since SpaceImaging has legal redistribution rights for this data. Ohioview hopes to work out a deal with SpaceImaging to make this data more cheaply available to their members. OhioLINK has brokered deals in the past with SpaceImaging to purchase data for their members at a reduced cost.

The Ohioview effort grew out of scientists concerns over the high cost of satellite imagery. A Landsat-7 satellite image (called a 'scene' and covers an area about 108 miles square) costs around $4500 per scene. Ohioview will be able to acquire the data more cheaply through the government because they have United States Government and Affiliated User Status (USGAU). USGAU status means they can purchase data at federal government prices. Through Ohioview each scene from Landsat-7 will cost around $425. Any University can receive USGAU status for data acquisition, but the data cannot be used for any commercial purposes. The scientists can use the data to help state and local governments, such as in watershed management activities.

Ohioview is setting up mechanisms through the Internet to distribute the data. The searching mechanism is being developed by Miami University. NASA Glenn has developed some customized software for visualization and zooming in on the data.

The initial focus of the partnership is on providing Landsat 4, 5, and 7 to their members, but they may eventually expand their efforts. Their infrastructure is deigned to handled other remote sensing data formats, such as being able to handle IKONS SpaceImaging data.

This data clearinghouse model illustrates a more complex model where different partners are involved in different aspects of the collaboration, including providing funding, conducting data access research, and making purchasing deals. The clearinghouse is acquiring data from different sources at different prices and they have specific access and use restrictions for their users.

Pennsylvania Spatial Data Access (PASDA)

PASDA is a collaboration of PA DEP, Penn State University, and PA Geospatial Information Council

This state geospatial data clearinghouse provides

- **Metadata and data documentation service**
- **Data and metadata free through WWW and their datasets on CD-ROM**
- **Data storage**
- **User assistance, including some GIS training**

Services available to governments, community and watershed groups, schools, and businesses

State agencies required to post their metadata

The Pennsylvania Spatial Data Access system (PASDA)[26] is Pennsylvania's official geospatial information clearinghouse and the state's node on the NSDI. Started in 1995, PASDA was developed as a service to the citizens, governments, and businesses of the Pennsylvania. Its founding purpose was to provide the citizens of the Commonwealth of Pennsylvania with "free access to digital geospatial information and metadata, contributing to the knowledge of the state and wise use of its resources."[27]

PASDA is a collaborative project of Pennsylvania State University, Pennsylvania Department of Environmental Protection (DEP), and the Pennsylvania Geospatial Information Council (GIC). Pennsylvania GIC is a collaboration of seventeen state agencies. The Council's purpose is to develop data standards, to develop a state geospatial data framework, and to support the appropriate use of GIS by state agencies, local governments, businesses and the academic community. Pennsylvania GIC acts like a board of directors for PASDA. A major part of PASDA

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[26] For more detailed information about PASDA see the clearinghouse web site at: http://www.pasda.psu.edu/

[27] Kelly, Maurie Caitlin, "Pennsylvania Spatial Data Access: A New Land Grant Tradition," *Geo Info Systems*, October 1999.

funding is provided by the Pennsylvania Department of Environmental Protection. Pennsylvania State University runs this data clearinghouse.

PASDA provides three basic services. First, they provide free and easy access to data created by, for, or about Pennsylvania. Namely, they store and distribute Pennsylvania geospatial datasets. All their data and metadata are available for free through the WWW. They also provide datasets on CD-ROM. Second, PASDA provides metadata and data documentation service. PASDA staff will identify, document, and create FGDC standard metadata at the request of data stakeholders throughout the state. Third, the PASDA staff assists users in using the PASDA web site. They also provide limited assistance with their data and some limited GIS training. For example, they have trained PA DEP staff in the use of ARCVIEW. Their services are available to state and local governments, community and watershed groups, schools, and businesses.

PASDA also works to advance data access, storage, and search mechanisms to make geo-spatial data into more easily accessible and useful information for Pennsylvania citizens. For example, PASDA is conducting a project to develop a prototype interactive mapping tool to address economic development of a particular region. This project, which is funded by the Pennsylvania Department of Community and Economic Development, is called the Erie County Digital Mapping Project. This tool will allow users to query local data, (such as roads, streams, water supplies, demographic and economic information, and brownfield sites) and use it to help address decisions about locating their businesses or other facilities in the region.

PASDA data come mostly from federal and state governments. Pennsylvania DEP and Department of Transportation have been most active contributors so far. State agencies are required to at least post their metadata. Pennsylvania counties and NGOs, such as the Alliance for Aquatic Resource Monitoring, also provide data and metadata. PASDA is working to help more local governments put up their metadata, since some have been reluctant to participate. PASDA also helps to create new databases, such as the Pennsylvania Interactive Watershed Atlas, often through new partnership projects.

Data contributors can choose to put metadata only, or both the actual data and metadata on the site. PASDA data and metadata include: datasets about forests, watersheds, roads, geology, soils, and brownfields and other environment conditions; census data; digital orthophotos; and satellite images, etc. If only the metadata are at PASDA, then the user must contact the original owner to work out a deal to acquire the data. Currently, PASDA has hundreds of gigabytes of free data available through its clearinghouse web site. However, in the future, PASDA may charge for some data, especially since some of the counties want to sell their data.

Data suppliers are responsible for maintaining their data, i.e. data quality since they are the official dataset owners. PASDA maintains the metadata.

As of fall 1999, PASDA's web site was receiving more than 100,000 hits per month. Users visit the site to access the metadata and to download the free data. PASDA users are about 30% state agencies, 30% local governments, 20-30% academic and the rest are federal government, private sector, and other users.

This effort is still fairly new and evolving. In July 1999 they became the official state geospatial data clearinghouse. Because of this official state designation they recently received a significant funding increase so they will be able to expand their efforts. For example, they have started to do more data cleaning and database creation.

This clearinghouse model illustrates a collaborative partnership between a University and state agencies that provides both metadata and data through the clearinghouse web site to anyone for free. This clearinghouse model also performs some additional services, such as GIS training, metadata and technology development, and facilitating partnerships for data creation. This clearinghouse is also evolving and expanding its efforts over time.

State Geospatial and GIS Centers

Many states recognize benefits from coordination regarding geospatial data and technologies

States developing geospatial and GIS centers to

- **Facilitate coordinated use of data and systems within state and local governments**
- **Implement official statewide standards**
- **Create, distribute, and share datasets to government and public**

Efforts funded many different ways

State laws have a significant impact on way such efforts develop

During the last 5-10 years, many state, regional, and local governments have started developing, implementing, and using extensive geospatial databases and GIS systems. These governments recognize the many benefits from using such technologies to improve government services.[28] In addition, they have recognized the benefits from coordinating and sharing geospatial databases, standards and technologies to improve government services. To facilitate such coordination, most states have developed organizations called geospatial, geographic, or GIS centers. The National States Geographic Information Council (NSGIC)[29] helps facilitate and coordinate such efforts along with the NSDI. NSGIC is an organization of States committed to efficient and effective government through the adoption of

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[28] For a good example of the benefits and cost-benefits analysis associated with GIS implementation see: McInnis, Logan, and Stuart Blundell, "Analysis of Geographic Information Systems (GIS) Implementations in State and County Governments OF MONTANA," Prepared for the Montana Geographic Information Council, Helena, Montana, October 1998. On WWW at: http://www.nysl.nysed.gov/gis/montana/montana.htm

[29] NSGIC has useful information about such state geospatial efforts and GIS centers, see http://www.nsgic.org/noflash.htm. For more information about specific state GIS Centers also see http://www.nysl.nysed.gov/gis/related.htm

information technology, especially geotechnologies and the use of geospatial information..

The specific functions of these geospatial and GIS centers varies from state to state. However, most of them try to facilitate coordinated use of geospatial data and GIS systems within their state, regional and local governments. Many also help create and implement official statewide standards for geospatial databases and related technologies. These centers also create, distribute, and share datasets to government agencies and the general public.

Many of these state GIS centers also are involved in creating framework data for their states. Framework data is a widely available source of basic geographic data. The framework consists of basic geospatial data that are most needed, created and used by state agencies. Such a framework usually consists of at least seven minimum data themes: digital orthoimagery, elevation, geodetical control, hydrography, cadastral information, transportation and government units. Each state customizes what data make up their state framework efforts. Such framework efforts usually also involve procedures, technology, and guidelines that help different entities integrate, share, use, and maintain the data. Often partnerships are formed to help develop the framework data and related institutional relationships and operating practices. The NSGIC and NSDI both are helping facilitate state framework development efforts and coordinating such efforts at a national level.[30] Most states and many local governments are developing some sort of framework data, i.e. base GIS layers, as digital base maps for different state, regional and local applications.[31]

Regional and local governments are also developing such regional coordination efforts, especially in larger urban areas. For example, MetroGIS[32] is a Geographic Information Systems project that is helping local governments and other organizations share data in the seven-county

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[30] For more information on the NSDI and NSGIC concepts of framework see Sommers, Rebecca, 1997, and September 1999.

[31] See Sommers, Rebecca, September 1999, for some initial results from a survey of framework development activities of more than 5200 organizations across the US.

[32] For more information on MetroGIS see http://www.metrogis.org/

Twin Cities Area of Minnesota. The MetroGIS concept was started in 1995 by the Metropolitan Council, a regional government organization. OGETA[33], Open Geodata Consortium, is a public-private partnership to advance the use of shared geospatial information in the Greater Atlanta Metropolitan area.

State legal restrictions and legislation impact how such efforts develop. In some states, legislation has been passed that creates the GIS Center and specifies how it must be run. For example, California's GIS Clearinghouse, the California Teale Data Center, was created by state legislation that required it to eventually become self-supporting by charging for its services. In addition, state "Open Records" or FOIA laws can impact the centers choice of operations regarding data pricing and distribution. Such laws can require that any data produced with state funds must be in the public domain. For instance, both Wisconsin and Texas have such state "Open records" laws so their state geospatial clearinghouse data are in the public domain. Whether the data are in the public domain or not varies by state, because of such state laws and legislation, but also because of state customs and practices regarding data.

These state and regional efforts are funded many different ways. Often the funding comes from a consortium of sources. Such sources can include: different state and local agencies, NSDI or other federal programs, NGOs, and private companies. For example, the Georgia GIS Data Clearinghouse has a dataset development effort that receives funding from a range of sources including; state agencies, private companies, such as Georgia Power, and federal agencies. Some state clearinghouses are completely or partially self-supporting by charging for their services and data. For example, the California Teal Data Center's GIS clearinghouse is full cost recovery.

These state and local efforts are run and organized many different ways. Many are located in libraries, environmental agencies, or information technology agencies within the state or regional government. Often the location is determined by the history, such as the fact that

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[33] For more information on OGETA see http://www.ogeta.com/

GIS technologies and data were first used in the state information technology department. Often these clearinghouses are located in parts of the organization where they can be dedicated to their mission and perceived as separate neutral organizations. Even though a state agency runs the clearinghouse operations, the clearinghouse often has some sort of partnership that provides oversight or performs an advisory function for the state GIS Center. Sometimes such GIS Centers are run by a private company or an NGO organization. For example, OGETA is going to be run by a private company which is guided by a public-private collaboration.

We analyzed about a dozen of these state and regional GIS Centers, including: the California Teale Data Center, New York State Geographic Information Systems (GIS) Clearinghouse, Georgia GIS Data Clearinghouse, Texas Natural Resources Information System (TNRIS), North Carolina Center for Geographic Information and Analysis (NC CGIA), New Mexico Resource Geographic Information System (RGIS), MetroGIS, and OGETA. A few of them are discussed here. Many also serve as NSDI nodes, though some, like California Teale Data Center, do not. It is also important to note that some of these consist of a state data clearinghouse along with other collaborations to help direct it and/or other geospatial activities in the state, as will be illustrated when we discuss Montana. First, the California Teale Data Center is discussed.

California Teale Data Center

Located within state agency

Self-supporting GIS Solutions Group provides
- **Geographic information library**
- **Data integration and consulting services**

Range of cost agreements to acquire and to sell data to/from governments, universities & private sector
- **Buy data from commercial vendors for state and local agency customers only**
- **Partnerships to create data may require data in public domain; sell at cost of reproduction**
- **Universities get data at cost for research and educational purposes only**

The Stephen P. Teale Data Center[34], a California state department within the Business, Transportation and Housing Agency, was created over ten years ago to provide data and information services for state agencies. Teale has a GIS Solutions Group[35] that serves as a geospatial data clearinghouse for the state. The GIS Solutions Group provides a range of services.

They provide a library of highly relevant, and widely used geographic information for state and local agencies. The GIS Solutions Group maintains a data library of over 50 types of geography. This library contains such themes as roads, hydrography, railroads, vegetation, land ownership, public land survey, census, airbasins, administrative and legislative boundaries, national wetlands inventory, and terrain. Most of their data is regional data. Their data are copyrighted and they license their data to users with specific grants of use.

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[34] For more detailed information about Stephen P. Teale Data Center see: http://www.teale.ca.gov/index.htm

[35] For more detailed information about the GIS Solutions Group see their web site at: http://www.gislab.teale.ca.gov/

The Center's sells data to anyone, though their main mission is to serve state and county agencies. Many private sector customers use their data as well.

The GIS Solutions Group purchases most of their data, does some data processing, and then sells their databases to users. Their data processing is mostly to create regional databases at the scale and in the format most useful for their users, such as mosaicing datasets together. They acquire their datasets from federal and state agencies and the private sector. They own, maintain and copyright their databases. They also develop new datasets, often through individual data creation partnerships.

The GIS Solutions Group also provides GIS consulting services, which includes providing an introduction to GIS technology; analyses of client needs for GIS technology; custom application design and development; integration of GIS with other data processing technologies; and application of GIS analytical tools. They also provide GIS training and education; database development; mapping and plotting; address matching; and customized user interfaces for GIS databases. Their main selling point is "high quality" data and services.

California Teale Data Center has a wide range of agreements for acquiring and selling their data, based on the data sources, legal restrictions, and the deals that they can make.   The GIS library is available to clients by subscription at the county or state level and individual geographic themes can be licensed on a one-time basis. They license their data to individuals and organizations with specific usage restrictions.   They license their data to Universities at cost with the stipulation that the data only be used for research and educational purposes. In addition, certain data can only be sold to government agencies. For instance, they have licenses to purchase commercial data that they can only sell to county and state agencies, such as ESRI data products. The GIS Solutions Group negotiates individual deals with commercial providers to sell their data through their center. They try to and often do receive discount for sales to state and county agencies. They have agreements with other state and local governments to sell their data as well. All these examples illustrate how this

clearinghouse serves a unique middleman function where the Center purchases license data and then sells it, i.e. re-licenses it, to clients.

If there are no maintenance or acquisition costs associated with the data, they sell the data at the cost of reproduction. An example is that they sell their soils database at the cost of reproduction, since it came from USDA and they did not have to frame this data layer, i.e. did not have process it. Also, in certain partnerships to create databases, such as the Digital Raster graphic project, the data is considered in the public domain once it is created. Another example is the California watershed databases which is required to be in the pubic domain by the partnership that funded it.

During the last couple years they have had full cost recovery from the fees that they charge their customers. Initially they were subsidized by the state. Now they bill clients based on cost recovery, such as for staff time, data maintenance, and other infrastructure costs. Over the years they have worked out pricing mechanism to accurately allocate fixed and variable costs for their data and services. However, their consulting services is where most of their funds come from. They could probably not maintain the data library by itself as a full cost recovery system. About 30% of staff time is spent on the data library, the rest is spent on billable services.

Teale's GIS Solutions Group's largest customers are subscribers to databases, such as state agencies. However, 70% of their data products are purchased by private sector clients. Private sector purchasers include: utilities, water districts, environmental companies, insurance companies, etc.

They use a subset of the FGDC metadata standards which is the state standard.

The California Teal Data Center is a good example of a clearinghouse that provides a wide range of services. Besides distributing data, they act as a value added reseller and provide consulting services. They also are very customer oriented. This clearinghouse also has full cost recovery and is very creative in its data access and distribution deal making. This example also illustrates

a clearinghouse that is mostly a market type of partnership, but it also
has collaboration partnerships involved in creating datasets.

New York State GIS Clearinghouse/Data Sharing Cooperative

Clearinghouse operated by the NYS library provides access to state GIS metadata library and disseminates information about state GIS efforts

NYS GIS Data Sharing Cooperative to share the creation, use, and maintenance of GIS data sets

- **Governmental entities and NGOs**
- **State agencies required by law to participate**
- **Data creators retain ownership of their data sets, but share with members for free or cost of reproduction**
- **Users of data give corrections back to data creators**

The New York State Geographic Information Systems (GIS) Clearinghouse[36] is operated by the New York State Library. It was established to disseminate information about New York's Statewide GIS Coordination Program and to provide access to the New York State GIS Metadata Repository. Both of these efforts are being implemented under the direction of the New York State (NYS) Office of Technology with the help of the NYS GIS Coordinating Body.

The NYS GIS Coordinating Body coordinates, promotes, and facilitates the development, use, and sharing of geographic information in NYS. They held there first meeting in November 1996. This Coordinating Body consists of 15 members: five representatives from state agencies, five representatives from local governments, and five representatives from the private sector and academia. The NYS GIS Coordinating Body also creates public-private work groups to help address issues. Such groups include: the legal, the finance, the data coordination and standards, the digital orthoimagery, and the

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[36] For more detailed information about the New York State GIS Clearinghouse see their web site at: http://www.nysl.nysed.gov/gis/index.html. This web site is well done and has useful links to other clearinghouses and interesting GIS related articles.

clearinghouse and communications group. Additional advisory groups
consisting of local and state government and private sector
representatives provide input to the NYS GIS Coordinating Body on issues
that impact their sectors.

The Metadata Repository was created so that producers of geographic
data would describe what datasets they have available, and then GIS
users would use this information to find the datasets they need.
Additional GIS data about the State can also be found at the Cornell
University Geospatial Information Repository (CUGIR). CUGIR specializes
in providing environmental information. Both the NYS GIS Clearinghouse
and the CUGIR are NSDI Clearinghouse nodes for New York State. They
also both have metadata and data available through their clearinghouses
and the data are provided for free. They two clearinghouses work
together to avoid duplicate efforts.

Users find the datasets they are looking for through the Metadata
Repository web site by conducting a search. As a result of that search,
a list of datasets will be returned. The complete metadata record for
each dataset is presented, so that the user can determine if the dataset
is what they need and where to acquire it. In some cases, a map image of
the dataset can also be viewed. For some datasets, the file will be
available for free and immediate download through ftp. In other cases
the users have to contact the dataset owner to acquire and purchase the
dataset.

The Statewide GIS Coordination Program addresses issues of data
access, leadership, data coordination, and legal issues surrounding GIS
and geospatial data. As part of this Statewide GIS Coordination
Program, this state has created a unique partnership for data sharing,
called the NYS GIS Data Sharing Cooperative[37]. The NYS GIS Data Sharing
Cooperative is a group of governmental entities and not-for-profit
organizations that have executed Data Sharing Agreements for the purpose
of improving access to GIS data among members. The Data Sharing
Cooperative was primarily developed to encourage public agencies in New

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[37] For more detailed information about the New York State GIS Data
Sharing Cooperative see their web site at:
http://www.nysl.nysed.gov/gis/datacoop.htm

York to share in the creation, use, and maintenance of GIS data sets at the least possible cost. The clearinghouse is the information gateway for the Cooperative.

All State agencies must participate in the Cooperative by state requirements. Beginning in September of 1997, NYS agencies started signing the NYS GIS Cooperative Data Sharing Agreement, a standard licensing agreement. This standard license was adapted for local governments in January, 1998. Local government agencies are not required to join the Cooperative, but they are encouraged to do so. By signing a Data Sharing Agreement local governments, government agencies at the town, village, city, county or regional level, can join the Cooperative. Federal government agencies and not-for-profit organizations may also join the Cooperative. Currently, members include over 70 state agencies, over 70 local governments, 6 federal agencies, over 30 NGOs, and 9 organizations from other states. NGO and out of state examples include: Cornell University, the YMCA, TNC, Vermont Center for Geographic Information, and Delaware River Basin Commission.[38]

When they sign the Data Sharing Agreement, Cooperative members agree to share all their GIS data with other members for free or at the cost of reproduction. Members can only use other members datasets for their own purposes. The data owners are still free to sell their datasets to anyone outside the Cooperative at market prices. Signing members must also designate a GIS contact person and, if they have GIS datasets, submit an inventory of them. Members also create metadata describing their GIS datasets for inclusion in the NYS GIS Clearinghouse's Metadata Repository. Such NYS GIS datasets include administrative boundaries, hydrologic features, population densities, transportation features, land ownership, hazardous waste sites, natural resources, and agriculture data layers.

This unique data sharing arrangement also has unique maintenance, and quality control processes. Data creators, called primary

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[38] New York State GIS Clearinghouse, "Statewide GIS Data Sharing Cooperative Participating Agencies, Contacts, and Inventories," http://www.nysl.nysed.gov/gis/cooplist.htm, January 14, 2000, last accessed January 19, 2000.

custodians, retain ownership of their GIS data sets, but agree to share it with other Cooperative members for free or, at most, for the cost of copying it. Users of the GIS data, called secondary custodians, pass updates, corrections, and revisions back to the creators of the data set, resulting in improved data quality.

This data clearinghouse model provides an example of a unique data sharing collaboration with many members, over 180 members, where members share data and quality assurance, but can still sell their data in the marketplace.

Georgia GIS Data Clearinghouse

GIS Coordinating Committee - public-private consortium that directs state GIS activities

GA GISDC - consortium of state agencies and Universities

- **Promotes the development and shared distribution of state geospatial datasets**
- **Collects, enhances, maintains and distributes geospatial databases**
- **All datasets in public domain**
- **Acquisition free through WWW, otherwise nominal process fee**
- **Framework development: state base map**

The Georgia GIS Data Clearinghouse(GISDC)[39] was established in March 1996 by the Information Technology Policy Council of Georgia and is implemented by the University System of Georgia, with initial funding provided by the State of Georgia. The GISDC is a consortium of state agencies and Georgia Universities. The purpose of the Clearinghouse is to collect, document, format, and publish GIS information collected by multiple agencies of Georgia state government. This clearinghouse is trying to promote the development and shared distribution of state geospatial datasets to improve government services and public good throughout Georgia.

The GIS Coordinating Committee of the Georgia Information Technology Policy Council helps determine state policies related to the Clearinghouse as well as statewide GIS activities. The GIS Coordinating Committee (GISCC)[40] is a public-private consortium that directs state GIS activities and resources. It consists of nine members, including GA Department of Transportation, Department of Natural Resources,

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[39] For more detailed information about the Georgia GIS Data Clearinghouse see their web site at: http://www.gis.state.ga.us/about/

[40] For more information on Georgia GIS Coordinating Committee see http://www.gis.state.ga.us/giscc/

Department of Health, Bell South and Georgia Power. GISCC has developed
a business plan to help promote the long term development and use of a
Georgia Spatial Data Infrastructure, modeled after the NSDI.[41]

The GISDC collects, enhances, maintains and distributes geospatial
databases. Enhancement includes mosaicing and other processing to
standardize the data to what their state and local government users
need. The Clearinghouse also provides some data support to government
entities, such as troubleshooting with data loading problems. They do
not perform GIS applications nor research.

The GISDC has over 10,000 GIS datasets for Georgia. Most of the
datasets are developed by individual state agencies which are part of
this partnership, and each individual agency is responsible for quality
control of its datasets. Often the datasets are developed in
cooperation between the different entities. Funding for such dataset
development projects can come from a range of sources, including state
agencies, private companies (such as Bell South), and USGS. Often the
actual work of creating the databases is performed by a private sector
company for the agency or data creation partnership.

Part of their long range plan is develop and regularly update key
framework datasets for the state. Such framework datasets include the
following data layers: hydrology, transportation, wetlands, boundaries
DOQs, etc.

Currently, all GISDC datasets are in the public domain.
Acquisition of the GIS databases is free through the WWW, otherwise
there is a nominal process fee for such requests. Such fees are to
recover the cost of distribution only. Their users consist of about 25%
government, 20% educational, 35% commercial and 20% NGOs and others.
Government use is probably higher because many state agencies
redistribute data without going through the clearinghouse.

The GISDC has also tried to acquire some commercial remote sensing
data, such as SPOT and SpaceImaging data. However, the data was too
expensive for their access needs, which included being able to freely
distribute the data to all state agencies.

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[41] For more details on their plans see references: The Georgia GIS
Coordinating Committee, August 1, 1999.

Georgia is an example of a very pro-active state clearinghouse effort that has a well coordinated, ambitious, and strategic program for geospatial data sharing and development to enhance state activities and public good. This clearinghouse services focuses mostly on data production, sharing and distribution; they do not perform geopspatial consulting nor research. This clearinghouse is guided by a collaboration of state and private sector entities.

**Montana Natural Resource
Information Service**

**Montana NRIS, within the Montana State Library,
runs a state-wide GIS clearinghouse**

- **Meets the needs of the Interagency Technical
Working Group partnership**

NRIS provides state GIS databases and services

- **Purchase, clean and distribute datasets**
- **Conduct research and analysis**
- **Produce maps**
- **Have flexibility, based on project contracts**

**NRIS also runs the State Heritage Program and Water
Information System**

The Montana Natural Resource Information System (NRIS) Geographic Information System (GIS) acts as a clearinghouse for GIS databases. They also provide services to state, federal, private, NGO, and public groups or individuals needing access to GIS technology. The Montana NRIS GIS clearinghouse[42] is run by the Montana State Library. The GIS clearinghouse is designed primarily to meet the public needs of the Montana Interagency GIS Technical Working Group.

The Montana Interagency GIS Technical Working Group (ITWG)[43] was established in the mid-1980's out of a mutual interest of state and federal natural resource agencies to coordinate the collection and storage of GIS data among agencies, to document the usability of the data, and facilitate the sharing of those data themes. It is a partnership consisting of about 20 different state and federal agencies. ITWG acts as a forum for the exchange of information regarding the acquisition of new geospatial data, the existence of current geospatial data, and information relating to agency geospatial projects. ITWG

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[42] For more information about the Montana NRIS GIS Clearinghouse see http://nris.state.mt.us/gis/gis.html

[43] For more information about the Montana Interagency GIS Technical Working Group see http://nris.state.mt.us/gis/twg/twg.html

encourages agencies to minimize the duplication of digital data,
implement transfer technologies for the exchange of data, develop data
standards, and share resources through interagency projects.

The Montana NRIS GIS clearinghouse provides a range of state GIS
databases and services. This clearinghouse purchases, cleans and
distributes datasets. The data cleaning is fairly minimal and not a
major function. Most datasets come from Universities, federal and state
agencies, and the private sector. They also produce maps. In addition
they do some geospatial database design, creation, research and analyses
for selected clients. For example, they have developed land cover
databases for the USDA Forest Service. Basically, the clearinghouse
will perform whatever service a federal, state, or local government
client wants if they have a contract to perform and pay for that
function.

Most of their datasets are available for free through the WWW. The
original producer of the dataset is responsible for data quality. All
their data is documented in compliance with FGDC metadata and other
standards.

The NRIS also runs the Montana Natural Heritage Program and Water
Information System. The Water Information System is a statewide
collection of water databases for state agency needs.

The Montana effort is evolving over time. For example, two more
recent Montana GIS collaborations may impact the future direction of the
NRIS GIS activities. These two partnerships are the Montana Geographic
Information Council (MGIC) and the Montana Local Government GIS
Coalition (MLGGC). MGIC was created by executive order by the Governor
in September, 1997. The purpose of MGIC is to provide policy level
direction and promote efficient and effective use of geographical
information. MGIC may also establish priorities for statewide needs,
help in developing plans to meet those needs, simplify cost sharing,
encourage collaboration and cooperation to develop databases and
applications, and promote coordination of programs, policies, and
technologies. MGIC is comprised of fourteen members appointed from the
private sector; local, state, and federal government; the university
system; and the Native American community. The Montana Local Government

GIS Coalition (MLGGC) was initiated by local government GIS practitioners in July 1995 to facilitate and advance the implementation and development of GIS technology in city and county government through communication and data sharing. MLGGC consists of city and county agencies.

This clearinghouse provides an example of a state clearinghouse that provides a wide range of services for different government client needs. Much of their data is available for free, but they charge for other services. They are primarily directed by a collaboration of about 20 different federal and state agencies, but this oversight is likely to evolve in the future.

**Texas Natural Resource
Information System (TNRIS)**

TNRIS run by the Texas Water Development Board
- **Guidance from the Texas Geographic
  Information Council**
- **Centralized information system for state agency
  natural resource data**

TNRIS acquires, creates, and distributes state data
- **State law - state funded data in public domain**
- **Data free or cost of distribution**

Strategic Mapping Program
- **$40 million data creation partnership**
- **7 layers of statewide framework data**

The Texas Natural Resources Information System (TNRIS)[44] is the
state's clearinghouse and referral center for natural resources and
other geospatial data. TNRIS is an operational Division of the Texas
Water Development Board (TWDB), and is managed by this state agency.
However, the Texas Geographic Information Council partnership provides
the operational guidance and oversight for the TWDB. Basic operating
funding for TNRIS is provided by the state legislature through the TWDB.
Founded over 25 years ago, TNRIS was created as a centralized
information system for incorporating all Texas natural resource data and
socioeconomic data related to natural resources.

The Texas Geographic Information Council[45] is a geographic data
planning and coordination group serving state and regional government
agencies in the State of Texas. Official voting membership in this
partnership consists of over thirty governmental entities with statewide
responsibilities only. Such members include state agencies and local
government associations, such as associations of counties, council of

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[44] For more information on Texas Natural Resources Information
System see their web site at http://www.tnris.state.tx.us/about.htm
[45] For more information on Texas Geographic Information Council see
http://www.tgic.state.tx.us/

governments and river authorities. About ten universities and a federal agency, USGS, are also represented on this Council as non-voting members. The Texas Geographic Information Council deals with geographic data development, data exchange, GIS implementation, standards, statewide planning and policies. This Council also interacts extensively with the Texas private sector GIS group, called the Texas Mapping Advisory Committee.

The Texas Geographic Information Council has also developed a strategic vision for coordinated planning and collaborative use of geographic information and related technologies in Texas. This vision is based on five resolutions that act as implementation goals:

• To develop and maintain strategic partnerships with public and private sector entities

• To lead cooperative efforts to acquire geographic information that contributes to a public framework of digital data, i.e. base mapping development, such as the Strategic Mapping Program

• To promote public access to and sharing of geospatial data so that the benefits of public investment in geographic information is shared

• To develop and promote cost effective and accurate field data collection throughout the state

• To develop and maintain outreach and education about geographic information technologies and data

These resolutions were passed in November 1998. The Texas Geographic Information Council is using these five resolutions to develop strategic action plans. These five resolutions and the resulting plans provide direction and focus for TNRIS clearinghouse activities.[46]

The TNRIS clearinghouse acquires, creates, and distributes state data. They maintain an extensive library of both digital and paper data and provide information about state data available from other sources.

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[46] For more information about these resolutions and plans see, Texas Geographic Information Council, "Geographic Information Framework for Texas: Resolutions for Action," Austin, Texas, January 1999.

The state funds commercial vendors to create many of their datasets.
They provides a wide range of state datasets, including DOQs, scanned
versions of USGS topographic maps (Digital Raster Graphics), Digital
Elevation Models, and basic GIS data layers such as transportation,
water, administrative boundaries, and wetlands.

Besides acquiring and distributing data, TNRIS also help creates
partnerships to create new datasets and helps facilitate data sharing.
For example, in a special part of their clearinghouse is the
Texas/Mexico Borderlands Data and Information Center with is a
clearinghouse and referral center for information regarding both sides
of the Texas/Mexico border. Besides supplying datasets, this part of
the organization helps promote closer ties and communication in this
area. The TNRIS clearinghouse also provides some basic GIS education
and training for state and local agencies.

Texas state law requires that any state funded data is in the
public domain. All of TNRIS data are available for free through the WWW
or at the cost of distribution on CD-ROMs. Since datasets are free
through the WWW, anyone can use their data. TNRIS clearinghouse users
include: federal, state, and local government agencies, academics,
private companies, NGOs, and the general public. State and local
government agencies use TNRIS data extensively to improve public
services, however, private companies, such as environmental consulting
firms, also are frequent users of these data.

One of this clearinghouse's special projects is the Texas Strategic
Mapping Program, called StratMap. StratMap is a Texas-based cost-
sharing program to develop digital geographic data layers in partnership
with public and private sector entities. The goal of this effort is to
produce basic framework data that consist of standardized, compatible
statewide digital data for use by anyone needing spatial data in Texas.
This framework consists of seven data layers: digital orthoimages,
digital elevation models, contours (hypsography), soil surveys, water
features (hydrology), transportation and political boundaries. The
development of this basic framework data is costing $40 million, over
$10 million was allocated by the state legislature to create this data.
This effort was started in the mid-1990's and should be completed in

2001. The digital orthoimages includes layers at different resolution including: 30, 10 , 2 1/2 and 1 meter DOQs. The 1 meter resolution layer consists of over 17,000 images to cover the entire state. This dataset is being created from aerial photography RS data rather than satellite data. The actual work of creating these databases is mostly contracted out to private sector companies. TNRIS hopes to update the data layers on a regular basis, such as a four year cycle for updating the DOQs. This project has created an extensive amount of statewide geospatial data that anyone can acquire free access to through the TNRIS clearinghouse.

TNRIS provides a model of a long running clearinghouse that receives a large amount of state support and has significant collaboration among state agencies. This clearinghouse also has substantial investment in the development, maintenance, and free public distribution of geospatial data.

Natural Heritage Network/
State Natural Heritage Program

The Natural Heritage Network was started over 20 years ago by The Nature Conservancy (TNC) and today every state has a program

- **Standardized information on endangered plants, animals, and ecological communities**
- **States follow national standards but run own individual programs**

Adapted over time, now Association for Biodiversity Information (ABI) is dedicated neutral organization that runs the heritage network

The Natural Heritage Network[47] was originally started by The Nature Conservancy (TNC) over 20 years ago to collect, interpret, and disseminate information critical to conservation of the world's biodiversity. TNC worked in partnership with many independent public agencies and other organizations to develop individual state programs throughout the country. The US Natural Heritage Program consists of separate programs in all 50 states. The effort has also expanded outside the US. Using a common, standards-based methodology, natural heritage programs collect and distribute information on endangered plants, animals and ecological communities that make up our planet's biodiversity. Collectively these programs are known as the Natural Heritage Network. Today this Natural Heritage Network comprises 85 biodiversity data centers throughout the Western Hemisphere. Each of these centers functions as a geospatial database clearinghouse.

The databases developed by these programs identify species, natural communities, and ecosystems in need of protection at the local, regional, national, and global levels. For species, the databases include the scientific name, distribution and population trends, habitat

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[47] For more information on the Natural Heritage Network see http://www.heritage.tnc.org/

requirements, and ecological relationships. For natural communities, databases contain information on vegetation structure and composition, succession patterns, natural disturbances, and the distribution and rarity of specific community types throughout their geographic range. In addition, the databases track the quality and condition of each occurrence of a community.

Funding for the programs, including creating and running the clearinghouses, and database development and maintenance, has come from many different sources throughout the years and varies from individual state program to program. Such funding has included federal, state and local government; TNC; University; foundation; and other NGO funding.

Data in these clearinghouses come from many different sources, often from users of the databases. Individual state scientists and information managers collect, organize, contribute, and share data from this extensive inventory of rare species and ecological communities. These experts include federal, state and local government, University, TNC and other NGO scientists. Information on both species and communities is compiled from existing sources, including scientific literature, field guides, books, maps, and museum collections, as well as from direct contact with experts. In addition, the scientists conduct field inventories to verify the presence of these species, supplementing the preliminary data with information about the status and locations of each element of conservation interest.

The Heritage databases are used by many different users. The Natural Heritage Network responds to 70,000 information requests annually. The main users are the state and local government agencies responsible for natural resource management and protection. Corporations and the Federal government are the next most frequent users of the network. The main federal users are the Department of the Interior, the Department of Agriculture, and the Department of Defense. The government users are 72% of their users. Conservation organizations and other NGOs, researchers, and academics represent 14 percent of all requests, and consultants, corporations, and private landowners

constitute the remaining 14 percent.[48] The data helps inform land-use decisions for developers, corporations, conservationists, and government agencies and is also consulted for research and educational purposes.

This program has adapted over time especially its organizational structure. In summer 1999, the Association for Biodiversity Information (ABI)[49] officially took over running the heritage network. ABI is a new international conservation organization. In 1994, a federation of more than 70 Natural Heritage Programs, Conservation Data Centers and similar programs spanning the Western Hemisphere collaborated to form the Association for Biodiversity Information. ABI's mission is to unify, support, and represent the network of Natural Heritage Programs, Conservation Data Centers and other cooperators in the mission of collecting, interpreting, and disseminating ecological information critical to the conservation of the world's biological diversity. The Association helps the independent data centers to meet local needs and to operate as a network, to share resources and expertise, to cooperatively develop methods, protocols and systems, and to make quality biodiversity information more accessible and useful.

ABI is a true collaboration. The participating data centers govern the Association for Biodiversity Information. ABI has a board with representation from the Conservancy, the Heritage Programs and Conservation Data Centers, and from others interested in biodiversity conservation information. This Board of Directors is selected by the member institutions. The Board of Directors establishes ABI policy, determines organization-wide annual objectives, and sets the annual operating budget.

ABI is a dedicated and "neutral" organization to run the heritage network. ABI was created to overcome some of the difficulties that a single organization has in running such a large collaboration of diverse interests and representation. Even though the TNC is a highly respected and scientific environmental organization, it did not appear neutral

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[48] The Nature Conservancy, "Natural Heritage Network Overview and Evolution," http://www.heritage.tnc.org/nhp/nhpovv2.html, undated, last accessed January 24, 2000.

[49] For more information see ABI home page at: http://www.abi.org/AboutABI.cfm#Overview

enough in certain situations. For example, federal agencies can more easily work with a public-private collaboration like ABI, than they can with the environmental NGO TNC. It was also difficult for a national organization with other objectives to always appear and act neutral, when overseeing the collaboration of 50 independent state programs. For example, some state heritage programs felt the TNC acted like a "big brother" with too much input into their individual programs. Another example is the fact that Heritage funds had to compete internally within TNC with other organizational funding needs, such as land acquisition. The ABI can illicit funds for their own objectives without any conflicts. In addition, this new arrangement also overcomes problems encountered by the fragmented responsibilities of TNC and individual Network programs in developing, managing and aggregating Network data. To summarize, most importantly, it places "leadership for the Network in the hands of an organization dedicated solely to furtherance of the Network and the application of Heritage data to biodiversity conservation"[50].

State programs[51] follow the national Natural Heritage Network standards and guidance, but run their own individual programs. TNC developed standardized methods and a computer software package, the Biological and Conservation Data System, so the programs could exchange and analyze information across geographical and political boundaries. For example, several state Heritage Programs can pool information on a region or an ecosystem that encompasses several program's jurisdictions. Over the years, TNC has also supported the Heritage Programs by providing training and technical support, computer software and technology transfer, standard methodologies, compatible ecological classifications, and mapping technologies. Historically, as part of this effort TNC and now ABI, develops "benchmark data standards." Such "benchmark data standards" are the minimum set and type of data on conservation relevant biodiversity data which the programs collect and

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[50] Hilton, Jarel, *Building a New Organization for the Heritage Network*, Alabama Natural Heritage Program, undated.

[51] For information on each state program see http://www.heritage.tnc.org/nhp/us/usmap.html

follow. Individual state programs are responsible for own quality control in implementing the standards and developing the databases. Originally, the TNC headquarters developed the standards with minimal participation from state programs. This process has gradually changed over time, so that the state and other Centers have had more and more participation in the process. In fact, with the new ABI organization, they are essentially controlling the process.

Each state program is organized and run differently. Some programs charge for data, while others are not allowed to charge for data. Some are primarily run by state agencies, some by TNC chapters and some by Universities. Most of these clearinghouse examples are run by state agencies. We examined seven different state programs including: California, Oregon, Montana, Wyoming, Virginia, and Pennsylvania. We only focused on a couple of these cases in-depth; choosing examples that were most relevant for our study. Such cases are representative of the diverse organizational structures, namely, run by state agency, TNC chapter, or University. The California Natural Diversity Database[52], is a good example of an effort run by a state agency. The Oregon Natural Heritage Program[53] is an innovative effort run primarily by a TNC chapter. Wyoming Natural Diversity Database[54] is a clearinghouse that is run by the University of Wyoming.

Two of these are discussed here in more detail, the California and Oregon cases.

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[52] For more information on the California Natural Diversity Database see http://www.dfg.ca.gov/whdab/cnddb.htm

[53] For more information on the Oregon Natural Heritage Program see http://www.heritage.tnc.org/nhp/us/or/

[54] For more information on the Wyoming Natural Diversity Database see http://uwadmnweb.uwyo.edu/wyndd/SidebarHome.htm

California Natural Diversity Database (NDDB)

Run by California Department of Fish and Game

Continually refined and updated, computerized inventory of location information on California's rarest plants, animals, and natural communities

Anyone can submit data

- **Must be in NDDB standard reporting format**

- **Perform unique quality control**

Charge basic subscription rates that are different for private sector compared to non-profits/government

The California Natural Diversity Database[55] is the State Heritage Program for the state of California. The California Natural Diversity Database is run by the Wildlife and Habitat Data Analysis Branch, Habitat Conservation Division, California Department of Fish and Game. The Natural Diversity Database (NDDB) is a statewide inventory of the locations and condition of the state's rarest species and natural communities. The Natural Diversity Data Base is a continually refined and updated, computerized inventory of location information on California's rarest plants, animals, and natural communities. Their goal is to provide the most current information on the state's most imperiled elements of natural diversity and to provide tools to analyze these data. The NDDB became computerized about 10 years ago. It was one of the first state heritage programs to fully computerize their database.

They charge for their databases because it is part of their mandate. State legislation created the California Natural Diversity Database and stated that they should insure cost-sharing by all who use the NDDB. The fees collected from sales are used to helped pay program

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[55] For more information on the California Natural Diversity Database see their web site at http://www.dfg.ca.gov/whdab/cnddb.htm

expenses. However, it is not full cost recovery, state funds supplement the program. California vanity license plate program provide the state funds. They recover about $225,000. per year in fees, which is about 25% of the program's costs.[56]

NDDB data are organized geographically and taxonomically. Information can be retrieved by taxa or USGS map sheet (1:24,000, 1:62,500, 1:100,000 or 1:250,000 scale). Most NDDB clients request information by USGS 7.5' quad (1:24,000 scale).

Users can access data fee-for-service, for individual text reports and overlays, or by a subscription service for the entire database. The text reports can be generated by 7.5' quad, 1:100,000 scale map, by county, or by custom area. If the number of records exceeds 200 (a report of about 25 pages), they prefer to provide the information in digital format rather than hardcopy. They charge government and NGOs $4.00 per record and $8.00 per record for commercial clients. Obviously, reports vary in cost with the number of records involved. Their experience has been that the reports for a 7.5' quad average between $140 and $270. Computer generated overlays cost $30. each. Their basic subscription rates for the entire database are also different for the private sector compared to non-profits and government. The cost for the statewide database is $1,250. for government and NGOs and $2,500. for commercial companies.[57]

Their users include federal, state, and local agencies, University researchers and scientists, environmental groups and other NGOs, and private companies. Their main users are US F&WS, USDA Forest Service, state biologists, and environmental consultants (they often acquire the data for environmental impact studies and assessments). Only 8 of California's 58 counties subscribe, because of the costs associated with acquiring the database.

There are some unusual circumstances surrounding the fact that there are charges for NDDB data. Ironically, some federal representatives prefer to pay for such data because of the fact that when they pay for proprietary data it is exempt from FOIA. In addition,

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[56] California Department of Fish and Game, February 1999.
[57] Ibid.

California has a Public Records Act that states that government data do not have to be released if it is not in the best interest of California. Some of the state's counties have smaller budgets and they cannot afford to purchase the database. Because of the counties' situation, the management of this clearinghouse would like the option to charge or not charge for their data.

The NDDB clearinghouse does not pay for any for their data. They will negotiate deals to get data for free. For example, they receive some California Teale Data Center datasets in exchange for California Teale Data Center getting their database for free.

NDDB data come from different sources. Federal and state biologists submit data along with experts from Universities and scientific NGOs, such as the California Native Plant Society. Actually, anyone can submit data, such as species sitings, to their system. However, data must be in NDDB standard reporting format which conforms to the national program standards. This format includes a field survey form that includes the name of the biologist who identified the species. NDDB will put other spatial data that they receive, such as federal GIS data layers, into their format.

Mostly the clearinghouse relies on the supplier of the data for quality control. They do some quality control, which mainly consists of reviewing the survey forms used to submit data. First, they look at the names of the biologists who identified the data being reported, since they know the biologists throughout the state. They also look at the data to see if it is reasonable. If there are any questions NDDB staff call the people who submitted the data. They also will include any unusual information in their database. Namely, NDDB metadata includes specific details about the biologists who identified and reported specific species siting.

This clearinghouse example illustrates a state agency working closely in a team partnership with an NGO, TNC, to meet both the state's and NGO's goals. This clearinghouse is creative in how they acquire and distribute their data given their mandate and legal restrictions. This case also illustrate a clearinghouse that is focused only on acquiring and providing data and not on providing other services.

Oregon Natural Heritage Program

Managed by the Nature Conservancy in cooperation with the State of Oregon

Develop, acquire, maintain, and distribute data about state's rarest plants, animals, and natural communities

- **Most of data from feds who pay them to perform quality control and VAD for federal data**
- **Conduct R&D and develops Oregon's Gap Analysis for USGS**

Charge based on costs to provide the services

- **Subscription rates for main federal users**
- **Fee-for-service for private sector, non-profits & other government users**

In Oregon, the state Natural Heritage Program is called the Oregon Natural Heritage Program (ONHP).[58] It is managed by the Nature Conservancy in cooperation with the State of Oregon. As a state heritage program they develop, acquire, maintain, and distribute data about state's rarest plants, animals, and natural communities

The program was created in 1979 by the Oregon Natural Heritage Act, which was passed by the Oregon Legislature. Originally the Oregon Field Office of the Nature Conservancy ran the program. In 1989 the ONHP became an official state-TNC partnership and the program started to receive some funds from the state. Since then the Oregon Division of State Lands provides the ONHP with administrative support while TNC staff run the data clearinghouse. Today, the ONHP receives guidance from the Oregon Natural Heritage Advisory Council, which is under the oversight of the State Land Board.

The Oregon Natural Heritage Advisory Council is charged with planning for the conservation of the state's natural heritage resources and establishing a statewide system of protected natural areas in voluntary cooperation of public and private land managers. The

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[58] For more information on the Oregon Natural Heritage Program see http://www.heritage.tnc.org/nhp/us/or/

Council's nine members are appointed by the Governor and must include at least four natural scientist experts.

ONHP's database system includes Oregon's most comprehensive database of rare, threatened, and endangered species It includes site-specific information on the occurrences, biology and status of over 2,000 species throughout Oregon. This system includes the state's only database of natural vegetation, with descriptions and information on the occurrences and protected locations of all known ecosystem types.

Since 52% of the land in Oregon is owned by federal government, the federal government collects a large amount of biological data within the state. Most of ONHP's data comes federal agencies including US F&WS, Bureau of Land Management, USDA Forest Service, and the Army Corps of Engineers. Their data also comes from state agencies, such as the Oregon Department of Fish and Wildlife which collects data from public lands. State law has a provision in it that the Heritage Program cannot have data on "natural areas" on private lands without the owners permission. However, landcover data are not covered by this law.

This clearinghouse performs a range of functions. They acquire, help create, clean and distribute datasets. Some federal agencies, such as the USDA Forest Service, pays the ONHP to manage, process and perform quality control on their data. ONHP acts as a Value Added Developer by cleaning and processing the federal data. This clearinghouse also has a collaborative arrangement with the USGS Biological Resources Division (BRD) to conduct work for the National Gap Analysis Program.[59] They are completing the state Gap Analysis which includes developing, disseminating, and helping to interpret Gap analysis and other important biodiversity data. They also create and develop new datasets, sometimes through special partnerships. For example, the TNC will cost share with a federal agency to develop a new database that both think is important.

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[59] The National Gap Analysis Program (GAP) is a program to provide regional assessments of the conservation status of native vertebrate species and natural land cover types, and to facilitate the application of this information to land management activities. GAP is implemented as state-level projects and is coordinated by the USGS Biological Resources Division. It is a cooperative effort among regional, state, and federal agencies, and private groups. For more information see http://www.gap.uidaho.edu/gap/

ONHP also does some endangered plant and animal research and analysis.
For example, they do research and analysis to produce vegetation cover
maps and to help develop a national vegetation classification system.
Another example is that they did a watershed assessment for a watershed
council However, most of their work, as they prefer, is focused on
accumulating, standardizing, and putting together the biodiversity data,
and making it available to the public.

The ONHP charges for their data and other services to recover close
to full costs. They recover 80% of their costs and could recover more,
except they invest in special projects, such as the TNC paying to
develop new databases that would not otherwise be developed. This
clearinghouse charges a yearly subscription rate for main federal users,
such as the USDA Forest Service. The USDA Forest Service pays about
$20,000 to access ONHP's database, have their data cleaned and to have
their questions answered. Other federal agency yearly subscription
rates are lower because they do not include data cleaning. They also
provide their datasets and services at fee-for-service rates for private
sector, non-profits and other government users.

ONHP uses the National Heritage Program standards and software in
their efforts. They use FGDC metadata standards and standards for their
GIS databases because of their Gap Analysis work.

ONHP receives over 10,000 data requests per year; 90% of their
requests are from the public sector, while 80% of their users are from
the private sectors. Since many federal agencies just pay the yearly
fee and can submit as many requests as they want, they request data and
information more often.

This clearinghouse is another example of a state and NGO working
closely together in a team partnership to meet both organization's
objectives. However, in this example the NGO manages the clearinghouse.
This Heritage Program is also different from the last case, the
California NDDB, because it provides a range of services besides
acquiring and distributing data. ONHP performs extensive data
processing services, and some research and analysis.

EROS Data Center

USGS Earth Resources Observation Systems (EROS) Data Center

- **Stores, processes, and distributes raw remotely sensed land data**
- **NASA DAAC for Landsat data**
- **Performs research and analysis**

All data available at cost of reproduction by anyone except

- **Some Landsat TM data has commercial fee**
- **Self service data downloaded for free from WWW**

Work closely with customers to meet their needs

The Earth Resources Observation Systems (EROS)[60] Data Center is a data management, systems development, and research field center for USGS National Mapping Division. The EROS mission is

To promote new uses, new users, and new understanding of land information, so that others can understand our planet.

To ensure scientists, researchers, businesses, decision makers, and the public have ready access to the land information they need.

To safeguard and expand the world's largest archive of remotely sensed land data.[61]

The Center consists of four main branches: Computer Services, Data Services, Satellite systems, and Science and applications. The Data Services Branch is the main data archive, production, and information dissemination part of the organization. The Science and Applications Branch conducts research and analysis related to earth science issues.

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[60] For more information on EROS Data Center see http://edcwww.cr.usgs.gov/eros-home.html

[61] USGS, "EROS Data Center: ANNUAL REPORT, Fiscal Year 1998,"1999, p.4.

Examples of research and applications include urban dynamics, Mojave desert ecosystem science, and circumpolar Arctic vegetation mapping.

The Center is funded by USGS National Mapping Program and NASA. Most of their guidance and over site, about 3/4's, comes form USGS, but they also receive some guidance from NASA.

EROS Data Center's main clearinghouse function is to store, process, and distribute a variety of data, mostly federally funded RS land datasets. Their data includes cartographic data, satellite data, and aircraft data. This clearinghouse's aircraft data cover the U.S. while it's satellite data cover the world. Most of their data comes from NASA, USGS, and NOAA. They have a variety of USGS digital cartographic data products collectively referred to as US GeoData. EROS Data Center also runs a DAAC for NASA's Earth Observing System Program, part of NASA's Earth Science Enterprise initiative. This clearinghouse has also supported the United Nations Environment Programme/Global Resources Information Database, making environmental data available to developing countries. They also participate in research and applications activities in partnership with other federal agencies, such as the Department of Defense. For example, they helped used Landsat images to analyze drought and landuse changes in Africa in partnership with the U.S. Agency for International Development and African organizations. This clearinghouse also develops data processing and information extraction techniques, and provides some user training.

EROS Data Center's archives contains a very large collection of civilian remotely sensed data covering the Earth's land masses. This clearinghouse operates the National Satellite Land Remote Sensing Data Archive, a legislatively mandated program. This program involves maintaining a database of space-acquired images of the Earth for use in studying global change and other related issues. The clearinghouse's RS collection contains more than 4 million satellite images and more than 8 million aerial photographs[62]. Their aerial photograph collection goes back to the 1940's. EROS Data Center is the U.S. government distributor of Landsat 7 image data as well as the U.S. government provider of

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[62] USGS, "EROS Data Center: Exploring a Changing Planet," undated.

earlier Landsat datasets. Landsat 7 prices are set by NASA, USGS, and NOAA.[63]

EROS Data Center's charter from the Department of Interior requires that they charge the "cost of recovery" for their data distribution. The charges are not full cost recovery. Their fees are based on recovering the costs for the reproduction and distribution of the data. For example, they charge a client the cost of pulling a data tape, and placing the data on a CD-ROM, and sending it to the client. However, this is not all their costs and some data are available for free through the Internet.

To clarify this system we quickly explain it in slightly more detail. EROS Data Center has four stages in the process of supplying data: consultation, research, order production, and distribution. First is consultation, a customer calls, FAXes or e-mails the clearinghouse saying he or she wants an image. Staff spend time talking with the customer to understand what is really needed. Then the staff person researches to find the specific data and sends the potential client a free sample, called the research stage. Then if the customer decides to purchase the image, the staff makes the product; this stage is called order production. The last stage is distribution, the staff sending the image to the client. EROS Data Center only charges for the order production and distribution stages.

This data clearinghouse has two main methods for serving clients data needs. The first is a client self-service system where the users find the data that they want and download the data themselves off the web for free. For example, users can down load DLGs. Some data are still too large to have on-line this way. The second method is where the EROS Data Center staff helps the user find the data by the four stage process just described. Since this full service system costs the clearinghouse more because of staff time to conduct the consultation and research work, they are trying to make more and more data available through the self-service system.

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[63] A Landsat 7 scene costs $475. for level 0 data and $600. for level 1 data.

EROS Data Center's orientation is to make the data as widely available as possible. They also try to be, like many of the state clearinghouses, but unlike some federal agency efforts, very customer oriented. Often users call EROS Data Center without really knowing what type of data they need. For example, they say they want satellite images but they really need aerial photograph images. EROS staff spend the time helping the users figure out what data they really need, which is also why they send them a free sample. If it is in the best interest of the clients they will even send customers to someone else to acquire the data needed. They survey their clients about their needs frequently and report detailed user statistics.

EROS Data Center provides their data in raw format or geometric and radiometric corrections only, namely, raw data to extremely minimal data cleaning only. They provide data at these levels[64] because of legal limits and concerns by the VAD community. The value added developers buy much of their data and process and market it to clients.

This clearinghouse users include everyone: industry, academia, state and local government agencies, federal government agencies, school children, foreign governments and researcher, and other individuals. USGS, other U.S. federal agencies, and industry are their biggest customers. For example, in fiscal year 1998, the total number of digital data products purchased from EROS (not including those downloaded for free through the Internet), was 127,625 for the USGS; 69,416 for other federal agencies; and 61,386 for industry. In fiscal year 1998, total files of digital cartographic data transferred for free from the Internet was higher for industry users than the federal users: 1,257,212 for industry and 386,142 by all federal users.[65]

EROS Data Center also helps to create and participate in data sharing partnerships, such as Ohioview and the USGS/Microsoft "Terraserver" CRADA.

EROS Data Center also provides some special deals for clients. They have a Business Partner Program where anyone can buy selected data

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[64] NASA data level 0 and level 1 formats.
[65] Schultz, Nancy, 1999, p. 4 and 5.

at bulk rates and receive discounted prices. This Center also provides
some small grant programs so universities can acquire data for free.

EROS Data Center follows FGDC standards and is active in the FGDC
standards making process. This clearinghouse performs quality control
checks on its data before it leaves the building.

The EROS Data Center provides an example of a clearinghouse run by
federal agency that is, like many of the state examples, very customer
oriented. It functions mostly as a market with specific government
guidelines and restrictions on data acquisition, processing, and
distribution. However, it creates and participates in many other
partnerships. Besides data distribution functions, this clearinghouse
also performs some other services, such as research and analysis.

**Center for International Earth Science
Information Network (CIESIN)**

**Established in 1989 as a non-profit NGO to provide
information to help understand our changing world**

- **Most of funding comes from NASA**
- **Originally independent entity, now associated with
  research center at Columbia University**

Purchase data, add value, and make available

- **Most of their data is free through the WWW for
  science & educational purposes**
- **May charge for selected datasets in future**
- **Work out deals with individual data suppliers
  regarding purchasing costs & distribution rights**

The Center for International Earth Science Information Network
(CIESIN)[66] was established in 1989 as an NGO to provide information to
help scientists, decision-makers, and public citizens better understand
their changing world. CIESIN provides global and regional network
development, science data management, decision support, and education
and technical consultation services. A main part of their effort
focuses on providing Internet tools for data sharing and forming
partnerships to help create and make datasets available to their users.
They use to be an independent organization with their headquarters in
Michigan. Now they are associated with a research center at Columbia
University.

CIESIN provides datasets and tools to search, access, view and
analyze distributed data through the Internet. The CIESIN clearinghouse
groups their services into 5 categories: metadata resources, data
resources, interactive applications, information systems and resources,
and other services. Metadata resources includes metadata guides and
search capabilities by key topics, such as the Great Lakes Regional
Environmental Information System Metadata Directory. Another example is

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[66] For more information on CIESIN see the organization's web page
at: http://www.ciesin.org/index_text.html

the CIESIN Gateway that is used to locate socioeconomic and environmental data using distributed international catalogue of metadata resources. Data resources are specific datasets and guides that they provide for selected topical areas. For example, they provide full text documents of more than 140 international environmental agreements, called the Environmental Treaty Texts database. Another example is their China Dimensions Data Collection which consists of a wide range of information on the People's Republic of China. Highlights from this collection include digital administrative boundaries; fundamental GIS layers; county-level data on population, agriculture, economics and hospitals; and interactive access to census data. These data resources also include Global Population Database, Georeferenced Population Data Sets of Mexico, and the World Bank's Social Indicators of Development. Interactive applications refers to specialized tools used through the Internet to extract information from databases. One such tool is the Demographic Data Viewer which is used to view and map U.S. census data. Information systems and resources consists of tools and data used in specific analyses, such as tools for analyzing US demographics. Other services include related Internet Services, such as providing list server discussions.

Many of these activities and datasets are created through partnerships focused on specific application areas, under different CIESIN programs. The program areas include: the Global Change Research Information Office, the USDA/CIESIN Global Environmental Change Data Assessment and Integration Project, the Environmental Protection Agency Cooperative Agreement and the Socioeconomic Data and Applications Center (SEDAC). In these program areas, besides providing tools, datasets, and access to other peoples' datasets, CIESIN also performs some training, research, and analysis. We briefly discuss SEDAC here to further explain what this clearinghouse does and how some of CIESIN's partnerships work.

SEDAC is one of the Distributed Active Archive Centers (DAACs) in the Earth Observing System Data and Information System (EOSDIS) of NASA. SEDAC's focus is on human interactions in the environment. Its mission is to develop and operate applications that support the integration of

socioeconomic and Earth science data. SEDAC trys to serve as an "Information Gateway" between the Earth and social sciences. The SEDAC is guided by the User Working Group (UWG). The UWG reviews SEDAC's progress and performance; represents the user community perspectives in the development of SEDAC products and services; recommends data products and services to NASA and SEDAC; and provides strategic guidance to NASA and SEDAC on objectives, priorities, implementation approaches, and other issues. UWG is a collaboration of diverse members that represent a broad range of social and natural science disciplines and other user groups from Universities, government, industry, and NGOs. During fall of 1999 SEDAC had about 40,000 to 50,000 visitors/users per month to their web sites and Internet tools.

CIESIN receives most of its funding from NASA. This clearinghouse receives some additional funding from a few other U.S. federal agencies, such as EPA and USDA. CIESIN is the NASA DAAC for a special user community and they try to be responsive to their users. University scientists are one of their main user groups.

CIESIN has an international focus, providing metadata and data for datasets from around the world. These datasets come from government, NGO, and commercial sources. Most of their data is available free through the WWW. Some of the data can only be used for science and educational purposes because of data acquisition and distribution restrictions. CIESIN may in the future start charging fees for selected data to cover some processing costs. In the past the transaction costs were so high it was not worth charging a fee.

CIESIN follows the rules of the data purchasing licensing agreements regarding data distribution. CIESIN freely puts up data on their site that is in the public domain, such as federal databases. This clearinghouse works out deals with individual data suppliers regarding purchasing costs and distribution rights. With some data suppliers CIESIN staff negotiate so they can put the purchased data directly up on the web. For other datasets, CIESIN puts a product derived from the purchased dataset up on the web. For example, they have purchased commercial boundary data for Canada, added value and put the derived product up on the web, not the actual boundary files. In

other cases, they cannot distribute datasets, but they can provide
search tools and access to allow users to view and extract selected
pieces of information. For example, instead of providing a GIS dataset
of country populations the user can look at populations of individual
countries by clicking on the map. They work out deals on a case by case
basis. For instance, during fall of 1999, CIESIN was negotiating with
TNC about some of the TNC databases.

Their organization has evolved and adapted both organizational and
technically as needed over time. For example, they moved from being a
totally independent organization to part of a University research center
to provide them with the technical and labor infrastructure needed to
support their organization.   To illustrate technical adaptation,
consider how they developed the CIESIN Gateway before Internet
technologies were developed, but they adapted it to the WWW protocol to
keep up with technological advances. Similarly, their datasets metadata
are all now compatible with FGDC, NASA Directory Interchange Format
(DIF) and the military geospatial metadata standards. They are also
redesigning their system to be compatible with NASA's Open Archive
Information System.

This clearinghouse is an example of an intermediary NGO
clearinghouse focused on providing search and analysis tools, and data
access and information, through the Internet for specific application
areas. This organization is driven by a mission to provide science
information about earth resources to researchers. It provides a large
amount of data from both public and private data sources. This
clearinghouse has adapted over time both from a technical and
organizational standpoint to meet evolving needs. One important need
was to have a critical mass of technical expertise available to support
the organization. Namely, they needed a solid technical infrastructure
to sustain the organization.

Journal Storage Project: JSTOR

Non-profit organization created to save researcher time and library storage space

Electronic database of academic journals available through the WWW

- **JSTOR digitizes & provides back issues of journals; no impact on normal journal service**
- **No money to publishers; they receive benefit from archiving, visibility and special projects**

Universities and other institutions pay onetime database development fee and yearly subscription fees to help maintain and update the online journals

The Journal Storage project, called JSTOR[67], is a nonprofit organization established in August 1995 to help save researcher time and library storage space. JSTOR produces and provides an electronic database of back issues of academic journals that researchers can quickly search and access through the Internet. This system helps research libraries save shelf space for back issues of academic journals and helps researcher access journal articles more quickly, cheaply, and easily.

JSTOR is run by a Board of Trustees which is composed mostly by their user community. This Board consists of about 12 members, the majority being University representatives. It also includes one publisher, two representatives from the Mellon Foundation, and one corporation representative. They function as an active Board of Directors, providing governance and oversight for the organization.

JSTOR has received permission from selected journal publishers to scan their complete back runs of selected journals. Such archives often cover many decades. JSTOR scans all the old journal articles to create digital versions. They process the articles and make them available in

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[67] For more information on JSTOR see http://www.jstor.org/about/

a full text search system through the WWW. The database does not include the last few years' issues so they do not hurt the publishers' current journal sales. JSTOR does not pay the publishers any money to create these electronic versions of their publications. They also do not give the electronic versions back to the publishers for free. The publishers receive benefit from the archiving of the journals and the visibility from the JSTOR service. JSTOR also will give the publishers some data for some special projects. For example, if a publisher was creating an anthology which included back issues, JSTOR may provide their data. The publishers of the journal, such as professional societies, can purchase selected journals at discounted rates. They receive discounts because they have a different usage structure from University customers. Therefore, they pay a different set of fees because their costs are different.

JSTOR may not have any data acquisition costs, but the processing, i.e. digital conversion of the journals, has significant costs. JSTOR wanted to achieve full cost recovery and needed to pay for a large up front investment to get the system started, so JSTOR has careful calculated their fixed and variable costs. They have grouped their costs into six categories: production, conversion, storage and access, software development, user support, and administration and overhead. Some of these costs are one-time capital expenditures while others are on-going operating costs. JSTOR's cost structure for converting a journal to digital form consists of a large one-time conversion cost followed by smaller annual maintenance costs. Based on their analysis of their costs and to recover full costs, JSTOR decided to charge a onetime database development fee and yearly maintenance fee to their customers.

JSTOR also wanted to have a fair pricing system. They chose a value-pricing approach in which they try to match the amount that institutions pay with how much they are likely to use the service.[68] Therefore, they charge customers based on the institution's size and the level of graduate degrees awarded. There created four classes of

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[68] See Guthrie, Kevin M., 1997, for more details on JSTOR's costing and pricing calculations and approach.

customer categories each with different fees: large, medium, small, and very small. Universities, colleges and other institutions class pay a different onetime database development fee and different yearly subscription fees based on their size. The database development fee ranges from $10,000 for a very small college to $45,000 for a large institution. An institution's annual subscription fee ranges from $2,000 for a very small institution to $5,000 for a large institution. The annual fees help cover the costs of updating and maintaining the electronic archives. Fees are posted on the web and fixed by the size class of the organization. However, discounts were available if an organization took advantage of a special deal for charter participants when JSTOR first started the service. If an organization chooses to discontinue the service they receive a CD-ROM at the time of termination with all the JSTOR back issues on it so the library can maintain their journal archives.

JSTOR began as a pilot project with a $4 million Mellon grant. Providing actual services to research libraries began in early 1997. As of fall 1999, JSTOR was working with over 110 academic publications and had a subscriber list of more than 550 institutions worldwide. JSTOR has some larger University users that print out 20,000 - 30,000 articles from their system per year. They have had many more subscribers than they originally thought and are expanding their service. The clearinghouse is now totally self-supporting, with JSTOR's operating costs being covered by fees from participating institutions.

JSTOR is expanding their service by adding new categories of journals. They surveyed their members to try to decide what types of journals to add next. They are going to create different clusters of journals by different topic areas. For these new clusters of journal collections there will be new and separate fees for each cluster because the costs will be different. Future JSTOR users will be able to pick and choose which clusters of journals they want to subscribe to.

JSTOR is trying to raise some additional outside funds to subsidize new journal scanning and processing so they do not have to charge customers as much. They are also raising funds to subsidize the purchase of their services by developing countries' Universities.

In their effort JSTOR has also impacted the evolution of library standards. For example, the International Consortium of Library Consortia essentially adopted the standards that they developed for reporting Internet usage statistics.

This clearinghouse example presents a dynamic system that is evolving over time. It is an independent clearinghouse run by an active partnership of primarily University researchers and librarians, who are their main users. This clearinghouse uses a value-based pricing and price differentiation approach based on size, to set their prices and achieve full cost recovery. Perceived fairness of system by users is also an important aspect of this system.

This clearinghouse provides a successful model of sharing electronic data to University scientists (through their libraries) from private sources (i.e. journal publishers). Furthermore, they have developed an efficient pricing structure where the Universities save money and the private companies feel they receive appropriate compensation for the data they supply even though they do not receive any monetary compensation. An important part of this structure is that only older data are available through the system so that the publishers can still charge normal rates for their normal print journal service. In addition, this program provides an important archiving service for the information.

NIMA's Central Imagery Tasking Office (CITO)

Detailed plan for making commercial satellite imagery available to the defense and intelligence communities

- **Improves timeliness & dissemination of imagery**
- **Enhances customers ability to search for and access commercial imagery within CSIL & from providers**

Flexibility in how customers can order commercial imagery thru classified and unclassified web sites

- **Link directly to the provider**
- **Electronic order form**
- **With assistance of NIMA's CITO**

The National Imagery and Mapping Agency (NIMA) also has a Commercial Imagery Program where they buy data from commercial providers for their military and intelligence community users. NIMA is using commercial imagery to satisfy selected geospatial requirements, to help fill gaps in their imagery collection, to meet their customers demands for unclassified data products, and to support unique and emerging applications. NIMA's program is similar to the NASA SDB except it is for NIMA's customers, namely, the U.S. military and intelligence communities.

NIMA's Central Imagery Tasking Office (CITO) is the implementation body for this program. The CITO also runs the national imagery[69] clearinghouse system for their user communities. The CITO serves as the central tasking and ordering service for commercial imagery for the defense and intelligence communities. The Commercial Imagery Staff Office within the CITO has the actual responsibility for receiving, processing, submitting, and monitoring satisfaction for all commercial requirements.

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[69] National imagery refers to imagery collected by U.S. military and intelligence systems.

As part of their Commercial Imagery Program, NIMA has developed a U.S. Imagery and Geospatial Information Service Concept of Operations Plan. This detailed plan provides a structure for creating a clearinghouse function that makes the commercial satellite imagery available to the defense and intelligence communities. This plan is designed to improve timeliness and dissemination of imagery to their clients. It also enhances customers ability to search for and access commercial imagery within the NIMA Commercial Satellite Imagery Library (CSIL) and from commercial providers.

Within this clearinghouse NIMA has designed the system so there is flexibility in how customers can order commercial imagery through classified and unclassified web sites. The customers can order data in one of three different ways. In the first option the customers link directly to the provider and order the data themselves. The second option is that they can use an electronic order form that NIMA provides. The third option is that customers have NIMA's CITO assist them in their efforts. In this last option, their customers can remain anonymous to the commercial providers and NIMA's CITO does all the processing, acquisition, and delivery of the commercial data to the customers.

NIMA is also developing a commercial imagery management tool that helps users in searching through existing imagery, checking order status, and planning new data collections. This tool will be available through the web and made easy for their customers to use.

NIMA already has contracts with SpaceImaging, EarthWatch and OrbImage to provide them with metadata of their most recent imagery on a daily basis. NIMA also purchases imagery data with different types of licenses from such providers and makes it available to clients. NIMA will also receive and post metadata from the EROS Data Center about Landsat 7 data and other imagery that the EROS Data Center has. NIMA establishes their own metadata standards for these data suppliers.

This clearinghouse is an example of a federal agency that provides a flexible system for other federal clients to acquire commercial remote sensing and other RS metadata and data from their clearinghouse.

5. OBSERVATIONS AND CONCLUSIONS

Outline

Research approach

Lessons from traditional public-private partnerships

Data clearinghouse models

Observations and conclusions

In this section we present the observations and conclusions from this case study partnership analysis. First, we compare and contrast the successful data clearinghouse efforts to identify commonalties and differences. Then we discuss some overall study conclusions based on the data clearinghouse analysis as well as the study of the other partnership examples.

It is important that the reader not generalize too much from this study. There are many different partnership efforts and the focus and scope of our study and our sample size were limited. These conclusions apply for the cases we examined. The conclusions are not necessarily representative of all partnerships, not even all data sharing partnerships. In fact, our sample is quite biased since we mostly focused on examples that appeared successful and involved sharing data among many different users and suppliers. Additional research should be conducted in this area, especially for different objectives. For example, to make any conclusions about state GIS Center or NSDI nodes

more extensive studies of such efforts would be required. Therefore, we caveat the reader about generalizing from these results.

> ## Observations About Successful Cases
>
> **No single organizational structure**
>
> **Wide range of services provided**
>
> **Management approaches vary across cases**
>
> **Wide range of pricing and access deals**
>
> **Different approaches for handling data quality**
>
> **Standards play an important role**
>
> **User communities help control the system**
>
> **Collaborations take advantage of technology advances and infrastructure**

Some general observation can be made about the successful data clearinghouse case studies. We briefly outline each area here and then present a slide on each which explains each issue more in depth. First, there was a great diversity in the organizational structures of the successful cases. Second, we found that there was a wide range of services provided by the data clearinghouses. Third, management approaches were different across the cases. Fourth, there were a wide range of pricing and access deals both in acquiring and providing datasets. Fifth, there were different approaches in handling data quality. Sixth, standards play an important role in data clearinghouse efforts. Seventh, the user communities help direct and control the clearinghouse operations. Last, the collaborations take advantage of technology advances and the underlying infrastructure provided by the technology.

No Single Organizational Structure

Team partnership between few organizations

Hierarchical collaboration

Equal collaboration of many different active partners

Market with intermediate organization or separate dedicated Center that provides services based on specific mission or mandate

Larger more complex systems may involve a combination of different organizational structures

→ **Most cases have dedicated "neutral" organization for implementation**

There was a range of different organizational structures in the successful data clearinghouse case studies. No singles organizational structure stood out. First, there were cases that had a team partnership with a couple to few organizations. For example, the Oregon Natural Heritage Program is team partnership between the Nature Conservancy and the Oregon Division of State Lands. Second, there were partnerships which essentially are a hierarchical collaboration of partnerships. For example, the Natural Heritage Program is a collaboration at its highest level, called ABI, but it consists of many other more local partnerships, the state heritage programs. Third, other cases primarily consisted of equal collaborations of many different active partners, such as in the NYS GIS Data Sharing Cooperative, MetroGIS and Ohioview. Last, other clearinghouses are mostly markets, with an intermediate organization or dedicated center that provides the services based on the specific mission or mandate of the clearinghouse. California Teale Data Center, NIMA's CITO and JSTOR are all examples of this type of market clearinghouse.

We found that many of the more complex clearinghouse efforts involve a combination of different organizational structures. For example, even though California Teale Data Center functions primarily as

a market partnership it also involves collaborations when it facilitates partnerships for creating databases. Similarly, TNRIS is essentially a collaboration of state agencies, but they also create additional partnerships with other entities for creating databases.

We did notice one important common factor in the organizational structures across almost all of the successful cases examined. Most of the cases examined have a unique center or even a separate non-profit organization created to run the data clearinghouse function. This center has a specific mission and is considered by the data user and supplier communities to essentially be a "neutral" entity in the sense that it clearly focuses on the interests of the clearinghouse. Namely, it is an objective party that focuses on its mission. We'll illustrate this important point by hi-lighting several of the clearinghouse examples. In both New York and Montana, neutral state libraries run the geospatial data clearinghouses. The California Teale Data Center is a special information center located within the state Business, Transportation and Housing Agency, where the clearinghouse can focus on its mission without conflict of interest with the state agency's function. Other cases had data impartial Universities running the clearinghouse operations, such as with PASDA and Ohioview. Even with the Natural Heritage Network which was started by TNC, the ABI was created as a new NGO to be a separate neutral organization dedicated to running the Natural Heritage Network.

Wide Range of Services Provided

Information broker where users acquire data on own directly from suppliers

Purchase data and make available, but data supplier maintains the original data

Create, own, maintain, and archive datasets

Add value to data, such as data integrator

Create partnerships to acquire or develop datasets

Conduct R&D or help develop standards

Provides technical assistance or consulting services

→ **Many have flexibility in services provided based on user needs**

Services provided differ significantly from one data clearinghouse effort to another and many provide multiple services. Some clearinghouses provide minimal services while others provide a wide range of services. On this chart we briefly summarize some these different types of services provided.

Many of the clearinghouses serve as information brokers for other organizations datasets. A few of these clearinghouses are information brokers only, where users must always acquire data on their own directly from the data suppliers. For example, the ONRC clearinghouse only provides metadata about Olympic Peninsula data through the WWW, and users go to the actual data owners to acquire it. Similarly, in the NYS GIS Data Sharing Cooperative members go to other members who are the actual data suppliers to acquire the actual data unless the data are in the public domain. Other clearinghouses provide their clients this informational option along with other functions, such as providing some data or helping the client purchase the data. For example, NIMA gives their users dataset information, so the users have the option of contacting commercial data suppliers directly themselves, or their users can use NIMA's acquisition services. In PASDA, the clearinghouse has some data available through their system and in other cases they only

have metadata, so the users must go to the actual data owners to acquire the data.

Some clearinghouses purchase data and make it available, but the data supplier maintains the original data, including legal licensing rights. This data supplier, often the data creator, assumes responsibility for quality control and any future revisions or updates. For example, the Ohioview clearinghouse purchases the actual Landsat data, but the suppliers own and maintain the datasets. Similarly, some of California Teale Data Center datasets, such as ESRI's products, are owned by the data supplier.

Many of the clearinghouses create, own, maintain, and archive datasets. California Teale Data Center licenses and maintains many of their own data products. Similarly, the California NDDB, ONHP and TNRIS are all examples of clearinghouses that create, own, and maintain many of their own datasets.

Some of the clearinghouses add value to data, such as being a data integrator. Many of these clearinghouses add value as they create new datasets or put existing datasets into useful formats. For example, both California Teale Data Center and Georgia GIS Data Clearinghouse mosaic datasets together to create useful products for their state, regional, and local client needs. CIESIN uses World Bank and other datasets and then perform analysis and integration with such datasets to create new data products.

Many of these successful clearinghouses create partnerships to acquire or develop datasets. Both TNRIS and Georgia GIS Data Clearinghouse have ambitious collaborative efforts to develop and update statewide framework data and base maps, through many different partnership arrangements. It should be noted that the actual work of creating the databases is often performed by a private sector company for the partnership. JSTOR, Ohioview, CIESIN, and California Teale Data Center also develop partnerships for acquiring or creating datasets.

Some of the clearinghouses also conduct some R&D and analyses. For example, CIESIN performs social and economic analyses to create some of their data products. Part of EROS Data Center conducts research to study earth science issues. The Oregon Natural Heritage Program

performs some plant, animal, and environmental related research and analysis, such as doing a watershed assessment for a watershed council.

Many of the clearinghouses also help to develop standards. For example, Montana NRIS GIS clearinghouse has been helping to develop state geospatial data standards. Similarly, TNRIS clearinghouse has input to state standard efforts.

Many clearinghouses provide some basic technical assistance for using their data. For example, the PASDA clearinghouse staff assists users in using the PASDA web site and also provide limited assistance with their data. Some of the clearinghouses even provide GIS or other specialized education and training for their clients. For example, PASDA also provides some limited GIS training to Pennsylvania DEP staff. TNRIS also provides some basic GIS education and training for state and local agencies.

A few of the clearinghouses also provide consulting services. For example, the California Teale Data Center has a profitable consulting service, which includes custom application design and development; integration of GIS with other data processing technologies; application of GIS analytical tools; database development; mapping and plotting; address matching; and customized user interfaces for GIS databases. CIESIN and Montana also provide some consulting services.

Many of the successful clearinghouses have flexibility in services provided based on their user needs, and based on their mission and legal restrictions. For example, Montana NRIS will perform whatever service a federal, state, or local government client wants if they have a contract to perform and pay for that function. NIMA also has been creating a flexible commercial RS clearinghouse to respond to their users diverse needs. Similarly, the ONHP, even though they prefer to be mainly a dataset creator and distributor, also performs some other functions, like research and analysis, based on its customer needs. Similarly, California Teale Data Center performs many of the services just described to respond to their customer needs.

Management Approaches Vary

Centralized management with a large amount of control by top management
- **Active board of directors**
- **System tightly run by the technical center**

Decentralized
- **Lead organization provides funding and/or technical information only**
- **Self-service type of system**

Mixed control
- **Partners working together**
- **Flexibility in system where user chooses**
- ➤ **Management is focused on clearinghouse mission and "neutral"**

Management structures, styles, and approaches varied significantly from clearinghouse to clearinghouse. Specifically, how management controlled the clearinghouse operations and management's control over clients' access to the data differed. This slide briefly illustrates some of these differences.

Some of the successful clearinghouses had centralized management with a large amount of control and direction from top management, often through an active advisory board or board of directors or by a tightly run technical center. For example, JSTOR is directed by an active board of directors, while California Teale Data Center clearinghouse is efficiently controlled by the Center itself.

Some of the successful clearinghouses had decentralized management styles where management had very little to no control over clearinghouse operations and the customers access to data. In some of these cases, the lead organization or main partner provided funding and/or technical information only, such as with parts of the NSDI program where USGS provides funding and technical support to help start a clearinghouse. Some of the clearinghouses had self-service type of data access systems, such as with the ONRC clearinghouse.

Some of the data clearinghouse examples did not have either decentralized or centralized management approaches. The management's structure and approach in running the organization could be considered, a mixed style, or something else. For example, some clearinghouse had partners working together, such as the Ohioview and the NYS GIS Data Sharing Cooperative examples. Other clearinghouses had parts of the operations that had centralized control and other parts that did not, such as the Natural Heritage Program. Other clearinghouses had flexibility in management style based on user's desires. For example, NIMA had flexibility in the system where the users choose how much control NIMA will have over their data purchasing process.

Despite the many different management approaches we found one common factor in the successful data clearinghouse examples. Management was focused on the clearinghouse mission and perceived as "neutral" by data users and suppliers. Irregardless of style or number of players involved in the management of the effort, the management did not have any significant conflicting objectives. Management focused on meeting the clearinghouse mission.

Wide Range of Pricing & Access Deals

Purchase of individual dataset means user can
- **Place data in public domain**
- **Use for own purposes only**
- **Distribute derived products only**
- **Distribute for non-commercial use only**

Subscription service for entire database
- **Charge flat rate irregardless of size & access**
- **Password access for selected individuals only**
- **Charge by total number of users accessing database**
- **Site or individual licenses**
- ➤ **Most clearinghouses exploit creative pricing and access approaches based on their legal limits**

We found a wide range of pricing and access deals across and within the different clearinghouse. Specifically, there was variety in what different clearinghouses paid for datasets and what they charged for datasets. For some clearinghouses, we also found significant variation in data purchasing costs and selling prices within the clearinghouse itself. This variation depended on where the data came form and was going to. Some of the clearinghouses distinguished access based on user organization types or purposes, often government and NGOs being different from commercial companies. Such usage and access also depended on the purchasing and licensing agreements for the individual dataset. We briefly illustrate some of these different arrangements here.

When a data clearinghouse acquires an individual dataset they could distribute it different ways based on the licensing agreement or other terms and restrictions that came with the data. First, some datasets, such as many federal databases, are in the public domain so anyone can use them, freely distribute, and access them. Similarly, in certain states, such as Texas, data created by state funds must be in the public domain, so TNRIS can distribute their state funded databases freely to anyone. At the California Teale Data Center they distribute their

watershed database at cost of reproduction to anyone because the data partnership to create it required it be in the public domain.

Second, some databases can be used by clearinghouse members for their purposes only. For example NYS GIS Cooperative members can only use other member's clearinghouse datasets for their own purposes and can not distribute or sell other members datasets. In Ohioview, only Ohioview's University members can use their data. In addition, since USGAU status was used for data acquisition of their Landsat 7 data, it cannot be used for any commercial purposes. However, their member scientists can use the data to help governments and in research.

Third, some data acquisition agreements state that the clearinghouse can only distribute products derived from the purchased dataset and/or access is limited to parts of the purchased dataset. For example, CIESIN cannot freely distribute the World Bank's Socio-Economic database, but they can distribute a product that they derived using this database or allow users to view pieces of the original database.

Fourth, some datasets can be distributed for non-commercial use or non-commercial clients only. For example, California Teale Data Center can sell ESRI data products to state and local government agencies only. Another example is the fact that some CIESIN data can be used for science and educational purposes only.

How a clearinghouse chooses to price their dataset varies quite a bit form clearinghouse to clearinghouse. This variation is based on their mission and legal restrictions. Some clearinghouses are required to have full-cost recovery, like California Teale Data Center. Other clearinghouses are required to charge minimal prices for data, like the California NDDB. While others distribute data for free or at the cost of distribution only, such as TNRIS and Georgia GISDC. Access charges are also based on the sources of the data and the licensing agreements that the data came with.

Some of the clearinghouses charge fee-for-service and/or have special subscription rates for their entire databases. For example, California Teale's Data Center GIS library is available to clients by subscription at the county or state level and individual geographic themes can be licensed on a one-time basis. The California Natural

Diversity Database and ONHP also both have fee-for-service and entire database subscription services available. In addition California NDDB prices are different by user types. For example, the cost for the statewide database is $1,250. for government and NGOs, and $2,500. for commercial companies.

These clearinghouses also employ agreements and licenses that are like what software vendors provide with their computer software. For example, a clearinghouse may provide password access for selected individuals only, or site or individual licenses, such as any 5 people can use the data at one time. Some clearinghouses charge a flat rate irregardless of size and access while other may charge by total number of users accessing the database. For example, JSTOR charges by size based on four classes; namely, by large, medium, small and very small research institution sizes.

Despite the many differences in data pricing and access approaches of the clearinghouses, one similarity stood out across most of the clearinghouses. Most clearinghouses exploit creative pricing and access approaches based on their legal limits. The clearinghouses were aggressive and creative in their deal making approaches given their mission and operational restrictions. For example, California NDDB clearinghouse is required to charge for their data, but they are able to create special deals with selected data suppliers to exchange datasets. Also, the actual deals made often varied depending on the source of data and/or who the users were.

Different Approaches for Data Quality

Original data producer is totally responsible

Collaboration's members jointly responsible

Data clearinghouse performs some data quality control (QC) functions

- **Minimal to high level**

Many use different QC based on data source

Most clearinghouses

- **Data producer responsible for QC unless the clearinghouse modified or created dataset**
- **Use metadata and other standards as part of QC**

Data quality approaches were different for different clearinghouse efforts. Some clearinghouses, such as ONRC, operate such that the original data producer or owner is totally responsible for the data quality. In some clearinghouse cases the collaboration's members are jointly responsible for quality control (QC). In the New York clearinghouse effort, members have signed the NYS GIS Data Sharing Cooperative and agree to share data quality responsibility. Primary data creators are responsible for maintaining their own datasets, but data users agree to report any revisions or corrections to the dataset creators, so that the original data creators can make the changes.

Other data clearinghouses perform some data quality control functions. The QC can range from minimal, such as minor data cleaning and checking to high level, such as being totally responsible for QC when they create the datasets. For example, the California Natural Diversity Database mostly relies on the supplier of the data for quality control, except the clearinghouse reviews the data survey forms to check some of the basic data, such as the scientists name who verified the data. California Teale Data Center performs minimal QC when they mosaic datasets together. However, California Teale Data Center, CIESIN, and

JSTOR maintain full responsibility for quality assurance when they actually create the datasets.

Many use different QC based on the data source. If the clearinghouse purchased the dataset, then the original data producer is responsible for QC. Namely, data quality assurance is generally provided by the primary data collector/creator. If the clearinghouse created or added value to the dataset, then the clearinghouse itself is responsible for the QC for their own work. For example, at the California Teale Data Center USDA is responsible for data quality for their soils database since the clearinghouse did not process it at all, while the Center is responsible for QC for their own data processing. Most clearinghouses normally provide assurance for their own data processing services and products.

In all efforts metadata, which includes information about who created the data, is an important effort of quality assurance. The data clearinghouses are using metadata and metadata standards to help maintain quality assurance. Such metadata are especially important when the data came from another source. The clearinghouses relies on this metadata to inform their users about data quality. They also rely on standards when other organizations are creating datasets for them. For example, when Texas NRIS contracts their database creation work to private sector vendors, the vendors must meet their QC standards. Other standards, such as the Natural Heritage Program national standards for the ONHP and California NDDB efforts, were also found to be an important part of quality assurance.

To summarize the commonalties, we found that most of the clearinghouses assume the data producer is responsible for QC unless the data clearinghouse created or modified the databases in any way. Then the clearinghouse is responsible for QC. In addition, we found that most clearinghouses use metadata and other standards as part of their quality control and assurance processes.

Standards Play Important Role

Formal or informal standards used in all data sharing efforts

Use of standards
- **Some follow informal standards, often near the beginning of process and formalized later**
- **Many use parts of state or federal standards**
- **Many innovative efforts help to create official and new standards**

Most of the efforts
- **Customize formal standards for their own needs**
- **Are active in standard making processes**

We found that standards play an important role in all of the clearinghouse efforts. As was just mentioned, standards are important for clearinghouses' quality assurance processes. We found formal or informal standards are used in all the data sharing efforts.

How standards are used varies from effort to effort, especially based on where they are in the process of creating the clearinghouse. Some clearinghouses follow informal standards, especially when their efforts first began before formal standards were approved. This occurred with some of the state GIS Centers, such as Montana, before the state had official geospatial data standards. Unofficial standards are used and then formalized later.

Many of the clearinghouse efforts use parts of state or federal standards. For example, CIESIN uses FGDC standards. Georgia GIS Data Clearinghouse cleans, documents, and converts acquired GIS data to comply with the state standards. ONHP and California NDDB both use the national Natural Heritage Program standards. California NDDB also uses a subset of the FGDC metadata standards which is the state standard. Olympic Natural Resources Center uses FGDC and NBII standards. Many of the efforts also customize formal standards for their own needs. The

California Teale Data Center uses part of the FGDC standards that are customized for state needs.

Many clearinghouses are active in standard making processes. Many of the more innovative efforts helped to create official and new standards, especially efforts that have been around for 5-10 years or more, because they were pioneers starting their activities before their were many geospatial standards in their areas. Therefore, they helped to develop the standards. For example, the Montana NRIS GIS and TNRIS clearinghouses have both been involved in state standard development efforts. Individual state Natural Heritage Programs provide input to ABI in their standards development process. Even JSTOR was instrumental in developing library standards for reporting Internet usage statistics.

To summarize the commonalties across clearinghouses, we found that most of the efforts use or customize formal standards for their own needs and are active in standard making processes.[70]

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[70] We need to state a special caveat to the reader about these observations. Since we looked at the more innovative organizations and ones that have been around a long time, they are more likely to be involved in standard making processes and to have customized standards for their own purposes. With more mature organizations and as such efforts become more common, such organizations may be less active in standard making processes and may be more likely to use existing standards without customizing them.

User Communities in Control

Strong connection to users interests in many different ways

- **The organization is run directly by the collaboration of users or subset of users**

- **The organization has board of directors with users on it**

- **The effort is recovering full costs from users**

→ **Users have direct or indirect control**

The data clearinghouse efforts had strong connections to users interests in many different ways. In some cases, the clearinghouse is run directly by the collaboration of users, or subset of users, such as with Ohioview and the NYS GIS Data Sharing Cooperative efforts. In other clearinghouses, the clearinghouse has a board of directors with users on it, such as with JSTOR. In the Montana and Texas NRIS clearinghouses, operational guidance came from collaborative councils, consisting primarily of users. Other data clearinghouses are indirectly responsive to their customers by financially succeeding or failing based on customer usage. Namely, these clearinghouses are recovering full costs from users by charging directly for services, and are meeting users needs or they would be out of business. California Teale Data Center is an example of such a clearinghouse.

Even with the few clearinghouses that do not have full cost recovery or users running the system, there was a strong connection to users interests. For example, the EROS Data Center is strongly customer oriented. They solicit customer feedback in many different ways and carefully track user statistics. Even though EROS Data Center is mainly a government funded program, it must also be responsive to clearinghouse

customers needs, because if it is not its funding will eventually be in jeopardy.

To summarize, we found that for most of the successful data clearinghouses that the user communities have direct or indirect control of the efforts. User communities are controlling the clearinghouse efforts often through actual participation, representation, or their pocketbooks.

Collaborations Take Advantage of Technology Advances and Infrastructure

Organizational structures, services, type of control & costs exploit technological advances in

- Geospatial/geotechnologies
- Internet, WWW, and other information technology development and use

Technology changes fuel new data sharing approaches

- Easier access and exchange mechanisms for geospatial data
- Geospatial data more affordable and more widely in use and demand

➤ Evolve significantly because of technology changes

These data clearinghouses take advantage of advances in technology to improve their operations. Most of the clearinghouses also have and exploit a strong technology infrastructure which helps support their efforts.

Over the last couple decades there have been tremendous advances in information technologies. There technology changes help fuel new data sharing approaches. These changes facilitate data sharing in numerous ways. Advances in geospatial and geotechnologies, such as GIS development and use, have helped make geospatial data more affordable and easier to use. Because of such changes these geospatial data and geotechnologies are more widely in use and demand. Internet, WWW, and other information technology development and use helps facilitate easier access and exchange mechanisms for geospatial data. Internet technologies ability to create many-to-many interactions so quickly, cheaply, and easily also helps fuel new collaborative approaches and partnerships.

Clearinghouses exploit technological advances to modify and improve their organizational structures, services that they provide, type of control they have and the cost and pricing approaches that they use.

For example, the WWW fostering many-to-many relationships helps enables new organizational structures with many different players, such as the over 180 members participation in the NYS GIS Data Sharing Cooperative. With such technologies it is also easier to have self-service systems where the users control the data information and acquisition themselves through the Internet, such as in ONRC's, NIMA's, and PASDA's clearinghouse efforts. An example of services evolving because of technology, is the ability to more easily transfer large datasets through the Internet and on CD-ROM, as EROS Data Center does. Pricing and cost approaches also evolve because of these efforts, such as clearinghouses now being able to charge for datasets through the WWW.

Almost all of the clearinghouse efforts have evolved significantly because of technology changes. It also appears that such trends are likely to continue.

**Additional Observations About
Successful Cases**

**Individual partnership, collaboration and data
clearinghouse efforts are unique**

**They take advantage of contributing organizations
strengths and cultures**

They adapt over time, including their

- **Cost mechanisms**
- **Organizational structures**
- **Technologies used**

Systems and benefits perceived as fair by all

**Efforts receive a critical mass of support and technical
infrastructure**

We found other similarities and differences across most of the
successful clearinghouse examples. First, the individual partnership,
collaboration, and data clearinghouse efforts are unique. These efforts
are complex systems that are organized and implemented in many different
ways based on each effort's mission, partners, history, and the legal
and cultural circumstances. Second, the clearinghouses, in their
partnership efforts, take advantage of contributing organizations
strengths and cultures. Each clearinghouse tends to recognize the
different motivations and skills of contributing partners, data
suppliers, and users, and exploits theses differences to advance the
clearinghouse efforts. Third, the clearinghouses adapt over time. This
adaptation can include cost mechanisms, organizational structures, and
technologies employed. For example, California Teale Data Center
evolved their cost structure over several years to achieve full cost
recovery. ABI is a new collaborative organization created to run the
Heritage Network. CIESIN evolved the technologies they used to provide
more efficient data searching capabilities and access through the WWW.
Fourth, the systems and benefits are perceived as fair by participating
entities. Namely, most potential data users and data suppliers see the
clearinghouse as treating users and suppliers fairly. Last, these

successful efforts receive a critical mass of support and technical infrastructure that enables them to sustain their efforts. Such support includes having sufficient leadership, funding, technological expertise, and other resources.

Summary

Period of experimentation
- **Especially for data sharing arrangements**
- **Traditional view of public-private partnerships limited**
- **Partnerships evolve over time**

New and changing roles in partnerships
- **Decreased role for traditional gate keepers**
- **Increased role for neutral facilitators**
- **Greater control by data user community**

Dynamic environment and advances in information technologies
- **Fueling new data sharing approaches**
- **Innovation likely to continue**

To summarize, there currently is a large amount of experimentation in partnership arrangements and implementation, especially for data sharing arrangements. Traditional views of public-private partnerships are limited. Partnerships are evolving over time. For example, today many data sharing partnerships are complex collaborations with more members and more members of many different types than in the past.

Evolving information technologies, such as the many-to-many communication mechanisms of the Internet, help fuel these new arrangements. For example, the WWW enables new mechanisms for partnership structures and facilitates many customers having more control in accessing data and information themselves.

There are also new and changing roles in data sharing partnerships. First, users have greater control in data clearinghouse partnerships. Second, there is a decreased role for the traditional gate keepers, those who use to have tight control over how and who accessed data. Last, there is an increasing role for neutral facilitators. These facilitators are intermediate neutral organizations that help customers acquire data faster and cheaper. For example, they can improve the market power of customers, such as making bulk buying deals for their clients. They also provide a centralized information source for

customers that provides timely information. They also can add value in the process. They also may understand customers and suppliers, and serve as a crucial link between these groups if there are barriers to direct contact. For government agencies, such intermediate facilitators often have greater flexibility in operations, because they do not have government restrictions. They also can add more fairness to the process because they are a more neutral party or balanced collaboration of interests. Therefore, they may avoid some of the biases of individual organizations with a direct stake in the process.

Data sharing partnerships are a dynamic environment. This innovation is likely to continue, especially because of technology advances continuing.   Given these partnership and technology trends, government's role in public-private partnerships is also changing and some agencies may need to rethink how they approach public-private partnerships for data sharing. Many different options should be explored. In approaching data sharing, especially geospatial data, it is important to be flexible, open-minded, and dynamic.

Last, we should note that it is important to conduct additional research in this area, since this study just touched the surface of such efforts and they are evolving so fast.

APPENDIX: NOAA-MAPTECH CASE STUDY

This appendix contains a detailed case study about a successful and evolving partnership, the NOAA-Maptech Cooperative Research and Development Agreement (CRADA), that offers useful lessons for NASA ESE's Science Data Buy (SDB).

Introduction

NOAA and Maptech have partnered through an innovative partnership to produce electronic nautical charts. Using a CRADA mechanism the private company, MAPTECH, now produces and sells CD ROMs containing electronic nautical charts which use to only be available in paper format through NOAA. This CRADA offers useful insights about public-private partnerships because it has brought to bear the incentives of the marketplace with government expertise and requirements to provide a better service to the public as well as benefits to industry.

Background

A nautical chart is a fundamental tool of marine navigation. Such a chart show water depths, aids to navigation, obstructions, traffic control schemes and other information critical to the safe and efficient use of the nation's waterways. NOAA is required to produce such charts. Nautical charts are produced by the Office of Coast Survey, National Ocean Service (NOS), NOAA, in Silver Spring, Maryland. This office has been tasked with the compilation and maintenance of charts for the safety of marine navigation and to support marine commerce in the United States. Certain high risk and high value vessels, such as large vessels over 1600 tons, are required by Federal regulations to carry these nautical charts for safety reasons. More specifically, these official charts insure that mariners have the best available information and that vessels sharing restricted waterways have the same information when they make critical navigation decisions. It is important to note that most of the shipping and recreational boating marketplace, 99%, is not required by any law to carry these nautical charts. However, many of

these vessels also carry them because of their usefulness and for safety reasons.

Electronic charting systems are revolutionizing marine navigation and improving safety. For instance, electronic charting allows for faster updates than traditional paper charting methods. NOAA pioneered the development of standards for the Electronic Navigational Chart (ENC) and the Raster Nautical Chart (RNC). The ENC is a database of charted items while the RNC is an electronic picture of an existing paper chart. Private companies started making electronic versions of NOAA paper charts for the 99% of the unregulated marketplace. NOAA wanted to develop ENCs and RNCs and considered many different mechanisms including contracting, free distribution of data to anyone wanting to make a product and certifying private products. However, NOAA's NOS did not receive any additional manpower or dollars to provide this new electronic chart production service. Thereby, because of concerns about the costs associated with providing this additional service NOAA examined public-private partnership options. They decided to implement a Cooperative Research and Development Agreement (CRADA) which would essentially cost the government nothing. In fact it was the first CRADA at NOAA. The CRADA was selected because it offered the greatest flexibility to meet evolving needs at the lowest risk and cost to the tax payer.

How the partnership works

Under the CRADA between NOAA and Maptech the company has exclusive access to NOAA digital chart data and certain technology, such as patented image compression processes for updating raster charts. Such exclusive access to government data is provided through CRADA agreements. Namely, a CRADA protects selected data, including government data, from the Freedom of Information Act (FOIA) to enable the private sector to collaborate with government on R&D and on the commercialization of the results; and earn a fair profit from their

efforts.[71] In exchange for such exclusive rights Maptech must produce
all charts that meet NOAA standards (not just the profitable ones);
issue new editions when NOAA does; provides an update service; make the
results openly available to all at an affordable price; and must do so
in perpetuity.[72] Maptech produces and sells CD ROMS of the electronic
charts called Chartkits. Maptech at their own risk and expense makes
these official ENCs and RNCs in collaboration with NOAA and profit or
lose in the marketplace based on the success of their sales. In
marketing the Chartkits, Maptech takes advantage of the NOAA brand name.
However, the current legal requirement for ships is still the NOAA paper
charts. The legal acceptance and official standards for electronic
charts have not yet been adopted by amending the chart carriage
regulations.

NOAA has negotiated a cap on the retail price of the electronic
chart products. NOAA also receives an R&D co-payment from all sales of
these products. These R&D co-payments are only used to fund NOAA R&D on
electronic charting. NOAA receives 5% of the gross sales of all
electronic chart products, which amounts to about $100,000 per year.

Maptech had to be more creative than the government would have been
to make their electronic chart production commercially viable.
Therefore, Maptech has done some innovative things to expand the
functional value of and the commercial market for the electronic charts.
First, they have added value to the NOAA charts in their final product
by adding additional features and capabilities, such as adding place
names on the charts. They are in the process of adding digital
orthophoto quadrangles (DOQs) to the charts to include visual reference.
A DOQ is a computer generated image of an aerial photograph in which

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[71] Under a CRADA, the data are protected from FOIA for 5 years.
Therefore, any NOAA nautical chart data that are five years or older can
be accessed by any US citizen through a FOIA request.

[72] The NOAA-Maptech is a four year agreement that is automatically
extended for another four years and so forth indefinitely unless either
party officially chooses to terminate the agreement when it comes up for
renewal every four years.

displacements caused by camera orientation and terrain have been removed. A DOQ's visual image is combined with the nautical chart to make a more useful chart product. Second, they have frequent updates and upgrades of the product which increases demand and generates sales of the revised products to existing as well as new customers. They have weekly chart updates available through the Internet. Third, Maptech has developed a network of over 100 registered Value Added Developers (VADs) to provide software that uses the electronic chart products. These VAD companies develop, produce, and sell special navigation software that uses the chart databases. For instance, a VAD may create a special software system using the charts for the kayaker or fisherman market. By developing such new specialty products the chart products are being sold in new niche markets. VADs are partners in technology development and have equal access to chart products. As of summer 1999 over 30 VAD products were on the market. These software developers are able to produce navigation software in a less risky environment because they are guaranteed the availability of high quality, affordable, consistent format and official data coming from the CRADA.

The retail price for a Chartkit CD ROM is $199.95 per region and each CD contains about 55 charts per region depending on the size of the region which works out to a price of about $3.60 per chart. The charts cover coastal and Oceanic regions throughout the United States. For instance, the U.S. East Coast is covered by 5 CD ROMs and the Chesapeake Bay, DelMarVa peninsula area is a CD ROM consisting of over 50 charts. To purchase an individual electronic chart on a diskette costs $14.95 each. NOAA's paper charts cost about $15.65 each. Paper charts sales have remained the same. However, as of summer 1999, the electronic charts were outselling paper charts 8 to 5, even though very large ships were still legally required to carry the paper charts for official navigational purposes. Given the increase in sales of the electronic charts compared to paper, the electronic charts are likely reaching new users, such as recreational boaters, and thereby, likely increasing public safety. Another reason why ships find the electronic charts more useful is because of the electronic positioning on electronic chart capability they provide. Mariners can use the electronic charts with a

GPS receiver to plot exactly where they are on the electronic chart in real time. With the paper charts and a GPS receiver they have to plot their location on the nautical chart by hand.

There are 100's of small retail chart sales agents that are the official retailers of NOAA's paper charts. They receive the paper charts at a 40% discount. They may now also sell Maptech's CD ROMS and the accompanying VAD software. For these CD ROMs they receive a 35% discount or more depending on what sort of deal they work out in the flexible commercial market place with Maptech. Some of these agents also give discounts to consumers, such as offering a 10% discount so that a CD sells for around $180. These agents were originally against the CRADA, but now they support it because they have also benefited from this agreement. They have benefited because they have additional products that they can sell that have a higher net profit than the paper charts, namely, the CD ROM's and the accompanying software products.

This CRADA is a true collaborative process that has improved NOAA's R&D and the commercializable development and technology transfer of government R&D. In this partnership the government, i.e. NOAA, performs fundamental research while the commercial sector, i.e. Maptech performs process research and development. Namely NOAA performs the applied research (by NSF definition) while Maptech performs the process engineering and development to make the product marketable. An example of this collaboration is the development and use of a process for updating the digital files electronically. NOAA had developed an algorithm and format by which old digital files can be compared pixel by pixel with new ones and then electronically updated, along with developing the compression technology by which this digital update could easily be distributed. Maptech made this pixel by pixel comparison process commercially practical. Namely, with this enhanced process mariners can easily update their own data files. NOAA and two other organizations had developed basic formats and algorithms for this process. Maptech tested these three methods with their VADs and clients to choose the best format for the marketplace. NOAA's format was chosen and Maptech validated it and made it into a useful product. NOAA has submitted a patent applications for this algorithm and compression

process which they will license to Maptech. Through this CRADA collaboration process NOAA's eyes have been opened to the opportunities of the marketplace and the synergies that the commercial sector has developed to create a more useful product.

To further illustrate this close working relationship and how it has helped the final product consider how Maptech gives on-going market and demand feedback to NOAA that their researchers use in their R&D. Maptech will point out to NOAA that they should gather additional data or process the data in a different way given the market demand. In addition, Maptech suggests different information that NOAA could provide to incorporate into the chart products. For instance, Maptech suggested NOAA provide Maptech with their electronic information about their Marine Sanctuaries because it is something the general boating public would be interested in. Maptech will incorporate this information into the product, which provides additional value to the product and helps NOAA in their educational mission to distribute information about the Marine Sanctuaries. A similar example is that Maptech requested the electronic Coast Guard "light list" database from NOAA. This database contains all the Coast Guard information about buoys, range lights, etc. Maptech incorporated this database into the chart product, which enhances the product by providing additional safety information. It should be noted that NOAA would provide this electronic database to whomever requested it since it is not protected under the NOAA-Maptech CRADA from FOIA.

Impact on Federal Agencies and Other Interests

NOAA's paper charts have always been sold to other federal agencies at a discount rate. Other federal agencies that purchase charts include the Navy, the Coast Guard and the Army Corps of Engineers. These federal agencies still receive the paper and the electronic charts at discount prices. All parts of NOAA receive paper charts free from the Office of Coast Survey, NOS. However, all parts of NOAA must now pay for the electronic charts. Some NOAA program managers were initially upset about having to pay for the electronic charts. However, they recognize and accept the efficiency in having the cost of the charts

transferred to the users, i.e. user fees, rather than them being subsidized by the Office of Coast Survey. Namely, the government now saves some money because the users have to pay for this service. In addition, NOAA saves a significant amount of money because they do not have to produce the electronic charts themselves. NOAA estimates it avoids over $3 million of expenses per year and over 12 government FTEs, who would have been needed to perform the same electronic chart production, marketing and sales function that Maptech performs. This estimate is based on the amount that the private company spent during the first two years to develop, manufacture, and market this product.

Because of the unique military requirements regarding navigation, NIMA and the Navy have always made their own paper charts and now make their own digital charts. However, Navy ships purchase the NOAA paper charts and Maptech CD ROMs for planning purposes.

NOAA considered many different options to produce the digital charts before deciding on a CRADA. For instance, they looked at producing the digital charts and making them available free over the Internet. However, this service would have cost the government a significant amount and other data producers objected to free NOAA data because it would put them out of business and the retail chart agents did not want to lose their chart product sales. The CRADA seemed the best option to balance many different interests. However, a few companies have objected to this CRADA on the grounds that it established a monopoly. It certainly gives Maptech a competitive advantage with the official NOAA brand name associated with the data in their product. However, there are four producers of raster charts and four producers of vector charts beside Maptech. Other companies with innovative electronic charts can enter the market at any time so it is not legally a monopoly. Given current technologies, such competitors can easily scan NOAA's paper charts to develop their own electronic data products. In addition, with over 100 VAD licensees and 600 retailers many different companies are participating in and benefiting from this agreement.

There are clearly benefits to this agreement, but often such agreements involve some tradeoffs and disadvantages, even if minor ones.

In this case, the question arises whether or not the public may have benefited even more if this partnership agreement did not grant Maptech exclusive rights to the data. For example, if the agreement stated that after 6 years the nautical chart data, even current data, would be available to anyone. In such a situation, one could speculate that there may have been even more competition in this marketplace resulting in reduced prices and more availability of the products throughout the world. However, one might counter argue that a private sector company would not have been willing to enter such an agreement, because of the small size of the market, or else not invested so fully in the product under such conditions.

One company, Delorme, did sue under FOIA, in Maine, in an attempt to get the electronic chart data from NOAA. This company makes maps and atlases and wanted to get into the nautical charting business and felt they should be entitled to the same electronic NOAA data that Maptech was using. However, this company lost their suit and the court upheld the CRADA agreement giving exclusivity to Maptech for the use and distribution of the NOAA electronic chart nautical data. In addition, two Italian companies that make a digital nautical charting product have been politically lobbying in the US and indirectly through the International Maritime Organization (IMO) against the NOAA-Maptech CRADA because they want to eliminate this US competition.

As part of their on-going R&D process NOAA has developed electronic nautical chart standards in cooperation with other governments charting agencies. These are the standards that they use throughout their Maptech partnership process. The IMO has adopted these NOAA standards for digital nautical charting. After standards are developed by the IMO the International Electro-Technical Committee (IEC) provides type approval tests for such standards. Once the IEC finishes, then the U.S. Coast Guard will most likely change the National Chart Carriage regulations so that the digital charts meeting this standard, such as the Maptech products, will become legally acceptable on ships for navigation. Namely, the electronic charts will accepted under maritime law for navigational purposes in place of the paper charts.

Challenges & Opportunities in Partnering: the Differences Between Government and Industry

Government and industry have very different cultures and incentives which can make it difficult to develop effective public-private partnerships that benefit both sides. Culturally, industry, i.e. Maptech, has more flexibility while government, namely, NOAA, has more restrictions on what they can do and how they do it. In addition, government's timelines to complete tasks often are slowed by bureaucratic requirements while in industry acting fast to gain competitive advantage in the marketplace is key. NOAA's measures of success regarding navigation charts is meeting mission requirements to produce a quality product that focuses on maximum distribution and inclusiveness while Maptech's measure of success focuses on profitable sales of products. This NOAA-Maptech CRADA was able to overcome such differences to successfully work together and meet both government and industry's success criteria. In addition, they were able to structure their partnership agreement in a way that took advantage of the different strengths of their individual organizations and cultures. For instance, NOAA's cultural orientation was to target coastal managers and scientists and fulfill their mission requirement of producing charts and making them widely available to whoever wants them. They did not think about other parties interests or unique needs for such charts, while Maptech thought more broadly about potential consumers and the marketplace, such as targeting commercial and recreational boaters in their product development plan. Maptech recognized that the marketplace was fragmented and that to make the chart production profitable a marketing plan was needed that enabled the product to be customized for the unique niche markets which led to the VAD agreements. Maptech also quickly changes the product to meet user's needs, which NOAA would not have likely done had they produced the electronic charts. Thereby, the charts are most likely reaching a wider audience and more quickly than they would have if NOAA had produced the charts without industry help and Maptech has a profitable product.

Summary of Benefits

This partnership has produced a range of benefits, for industry, the government and the public, including:

1. The raster charts are widely available, of high quality and affordably priced.

2. Value has been added to government data, namely, government data has been turned into more useful and widely available information.

3. The nautical chart product is self-supported from sales rather than being taxpayer subsidized.

4. NOAA R&D has been enhanced by the collaboration process. This enhancement includes both the real world feedback from Maptech and the additional funding from this R&D co-payment from product sales.

5. The sale of charts has increased, which has probably resulted in a wider use of the navigation charts and most likely increased public safety.

6. The commercial production of the electronic chart products and the accompanying VAD software has resulted in increased commercial sales for a number of different commercial firms.

The partnership has clearly achieved its mission and been a success[73] both for government and the private sector. To summarize the main outcomes:

- Government meets their important safety driven regulatory function, namely, NOAA's charting mission requirements.

- The private sector adds value and makes a profit at the same time, namely, Maptech meets their business mission.

- The CRADA has fulfilled its mission to advance technology.

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[73] Success here refers to the numerous beneficial outcomes from this agreement for the public, government, and the private sector. It does not mean that the agreement necessarily maximizes public good. The public certainly benefits in many different ways, as just discussed. However, theoretically the public may have benefited even more if an agreement had been reached that helped foster more competition in the private sector, namely, an agreement that did not give Maptech exclusive access to the NOAA data forever.

- New VAD software development is financed.

Lessons Learned/Insights for NASA SDB

This partnership focused on creating a useful information product. It did not focus exclusively on data or technology. It is important for those involved in the NASA ESE Science Data Buy, both government and industry, to recognize that possible products are not just data, but also information. Turning remote sensing data into useful information is what ultimately matters to scientists as well as other potential users and purchasers of such data. Understanding and focusing on useful information rather than data, opens the door for a wider range of approaches and possibilities in selling and using such data.

In the NOAA-Maptech CRADA, the commercial sector made sure the CRADA was set up so it focused on creating information useful to as broad a marketplace as possible. Maptech recognized that there were a lot of small specialty niche markets out there and set up the VAD agreements to help target them. With the NASA SDB, besides the narrowly defined NASA science community, there are a wide range of potentially useful niche markets out there. A critical question is how could the NASA SDB partnerships be structured to help take advantage of them?

Understanding the different incentives and cultures of government and industry and how to take advantage of them was key in the NOAA-Maptech partnership. What are the different cultures and incentives of NASA, commercial companies, and the scientists in the SDB? How might the SDB evolve to accommodate and take advantage of the different organizational strengths and interests?

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